SCIENTIFIC AMERICAN SUPPLEMENT. No. 1273

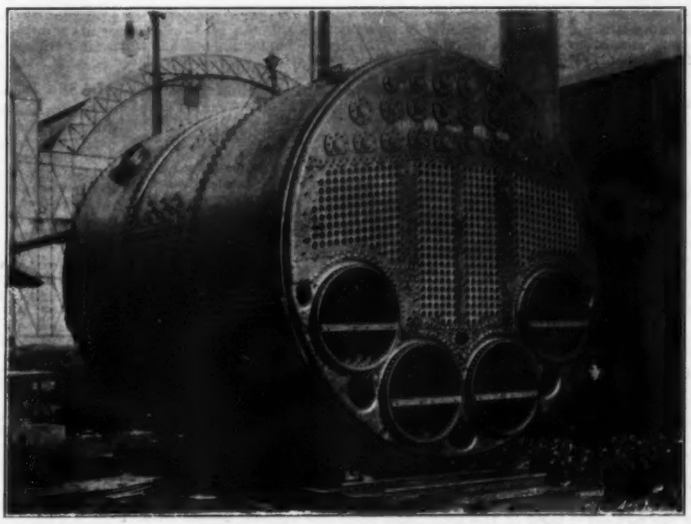
Copyright, 1900, by Munn & Co.

Scientific American, established 1845.
Scientific American Supplement, Vol. XLIX, No. 1273. NEW YORK, MAY 26, 1900. Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

ENGINES AND BOILERS OF THE "DEUTSCHLAND."

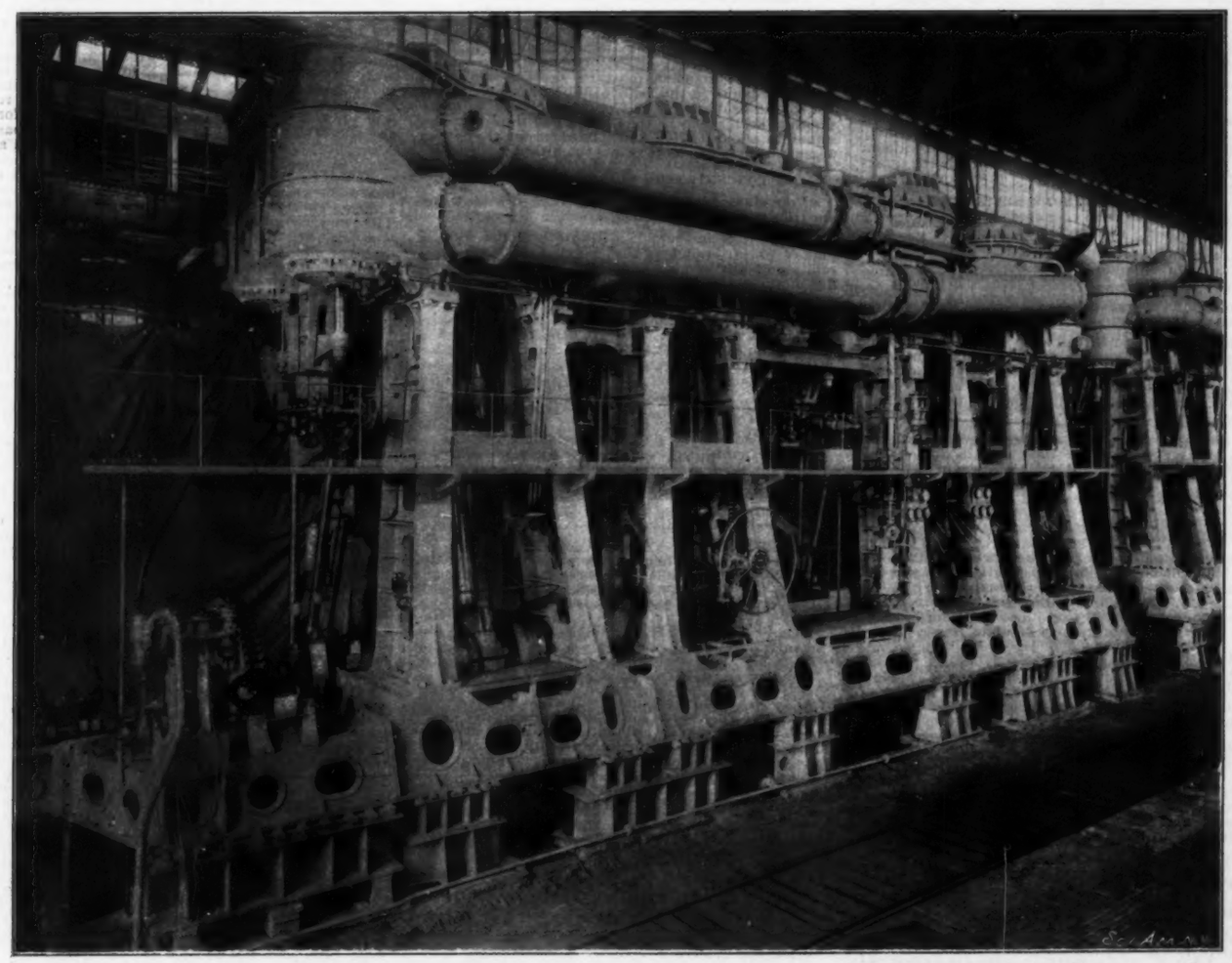
THE "Deutschland," the new vessel of the Hamburg-American line, was built by the Stettiner Maschinenbau Actien-Gesellschaft "Vulcan" at Bredow, near Stettin, where also the North German Lloyd steamer "Kaiser Wilhelm der Grosse" was constructed and engined. The "Deutschland" is equipped with engines of 33,000 indicated horse power, which is the greatest power ever fitted in any ship up to the present time. The vessel is 662 feet 9 inches long, and has a displacement of 23,000 tons, and it is expected she will leave on her first voyage to New York on June 17. While the "Deutschland" is 662 feet 9 inches long between perpendiculars and 686 feet over all, it is 38 feet longer than the "Kaiser Wilhelm der Grosse," the beam of the former being 67 feet, or one foot more than the latter. The molded depth is 44 feet, one foot greater than the "Kaiser Wilhelm der Grosse." The gross tonnage is 16,000 and the displacement 23,000 tons. In general appearance the vessel resembles the "Kaiser Wilhelm der Grosse," but the internal arrangements differ. The "Deutschland" has six cylinder quadruple expansion engines, as shown in our engraving. The illustration does not show the two high pressure cylinders in each set of engines. They are to be above the low pressure cylinders and work tandem, and their position is indicated by the beds cast on the cylinder tops. The erecting shop at the Vulcan Works, while very high, did not permit of placing these cylinders in position by overhead cranes.

The two low pressure cylinders are in the center, with the two high pressure cylinders over them, and at the forward end is the first intermediate and at the after end the second intermediate. The first two cranks, set opposite each other, have thus the intermediate in the one case, and a high pressure or low pressure cylinder in the other, and the after pair of cranks, a high pressure and a low pressure in the one case, and the intermediate on the other crank. The cylinders are placed close together, the valves being on the outside. There is a separate valve gear for each cylinder, that is to say, six sets for the six cylinders of each engine. The end cylinders have their valves boxed on the outside. The common stroke of the engine is 72·8 inches. The two low pressure cylinders are 106 inches in diameter and the intermediate pressure cylinders are 73·6 inches and 103·9 inches. The two high pressure cylinders have a diameter of 30·6 inches. The engines indicate 33,000 horse power when running at 76 revolutions per minute. Steam is furnished by twelve double-ended and four single-ended boilers divided equally into four sets of four boiler compartments. The working pressure is 225 pounds. The total heating surface is 85,434 square feet.



ONE OF THE BOILERS OF THE "DEUTSCHLAND."

DIAMETER, 16·16 FEET.



THE SIX-CYLINDER, QUADRUPLE EXPANSION ENGINES OF 33,000 INDICATED HORSE POWER, FOR THE STEAMER "DEUTSCHLAND."

SOME USEFUL PHOTOGRAPHIC FORMULÆ.

THE average amateur photographer, while occasionally a strong disbeliever in ready made solutions, can be induced to save himself the trouble if suitably prepared solutions are offered to him. The old style of preparation, the composition of which was in no way indicated, has gone out of fashion, and the tendency is to place on the market such things which, while the actual composition is not given, have at least some indication of their strength on the labels. Below we propose to suggest some preparations, and also suitable labels, and the approximate retail price.

TEN PER CENT. PYRO SOLUTION.

Metabisulphite of potash	½ ounce.
Pyrogallic acid	1 "
Potassium bromide	100 grains
Distilled water to	9 ounces.

Label: Ten per cent. pyro solution. Add 30 minims of this solution to ½ ounce of solution of common washing soda, made by dissolving 2 ounces in a pint of water, and add sufficient water to make 1 ounce. This solution will keep in good condition at least six months. If desired the soda solution may be made up, and in that case it should be made at least of 25 per cent. strength, and the label altered.

PYRO-AMMONIA TEN PER CENT. SOLUTIONS.

(1)	Liquid ammonia (880)	1 ounce.
	Distilled water to	9 "
(2)	Ammonium bromide	1 "
	Distilled water to	9 "
(3)	Potassium metabisulphite	½ "
	Pyrogallic acid	1 "
	Distilled water to	9 "

Label: Ten per cent. pyro-ammonia developer. For use take 60 minims of No. 1, 60 minims of No. 2, and 40 minims of No. 3, and make up to 2 ounces with water. For over exposure reduce the quantity of No. 1, and increase Nos. 2 and 3. For under exposure reduce Nos. 2 and 3, and increase No. 1.

ORTOL DEVELOPER.

(1)	Potassium metabisulphite	40 grains.
	Ortol	75 "
	Distilled water to	10 ounces.
(2)	Potassium carbonate	300 grains.
	Sodium sulphite	2 ounces.
	Potassium bromide	5 grains.
	Sodium hyposulphite	1 "
	Distilled water to	10 ounces.

Label: For use, mix equal parts of No. 1, No. 2, and water. This developer does not stain, and can be used repeatedly and keeps well, and is suitable for bromide papers and lantern plates.

PYRO-METOL DEVELOPER.

1.	Metol	45 grains.
	Potassium metabisulphite	½ ounce.
	Pyrogallic acid	55 grains.
	Potassium bromide	20 "
	Distilled water	10 ounces.
2.	Sodium carbonate	4 "
	Distilled water to	10 "

Label: For use mix equal parts of each and add an equal quantity of water. This developer is extremely energetic, and is specially suitable for hand camera work. For over and under exposure double the quantity of water.

METOL-HYDROQUINONE DEVELOPER.

1.	Metol	40 grains.
	Hydroquinone	50 "
	Potassium metabisulphite	120 "
	Potassium bromide	15 "
	Distilled water	10 ounces.
2.	Potassium hydrate	180 grains.
	Distilled water to	10 ounces.

Label: This developer will keep well, and is suitable for all plates and papers, and will not stain the negatives or hands. For negatives, mix ½ ounce of each and add 1 ounce of water. For papers, add 3 ounces of water. It may be used four or five times without disadvantage.

ONE SOLUTION METOL-HYDRO DEVELOPER.

Metol	50 grains.
Hydroquinone	40 "
Sodium sulphite	500 "
Potassium bromide	25 "
Sodium carbonate	500 "
Distilled water to	10 ounces.

Label: This developer will keep well, and will not stain hands or plates. For negative work mix an equal quantity of water; for papers add double the quantity of water. It may be used four or five times in succession.

GLYCERIN DEVELOPER.

1.	Glycerin	300 grains.
	Sodium sulphite	2½ ounces.
	Distilled water to	10 "
2.	Potassium carbonate	1 "
	Distilled water to	10 "

Label: For use ½ ounce of No. 1, ½ ounce of No. 2, and 2 ounces of water. This developer may be used four or five times in succession, and will not stain hands or plates. It is suitable also for bromide papers.

The above may be considered as the leading developers that are likely to be useful.

THE COMBINED REDUCER AND INTENSIFIER.

Potassium bromide	120 grains.
Cupric sulphate	250 "
Distilled water to	10 ounces.

Label: For intensification immerse the well washed negative in the solution till bleached, then rinse well and redevelop. For reduction immerse the negative in the solution till bleached slightly and then refix; the longer the negative is allowed to remain in the solution the greater the reduction.

THE SILVER INTENSIFIER.

1.	Mercuric chloride	100 grains.
	Ammonium chloride	100 "
	Distilled water to	10 ounces.
2.	Silver nitrate	100 grains.
	Potassium cyanide q. s. or	100 "
	Distilled water to	10 ounces.

To make solution No. 2 dissolve the silver in half the water and the cyanide in the remainder; add the latter to the silver, gradually shaking between each addition until the white precipitate first formed is nearly all redissolved, and then make the total bulk to 10 ounces.

Label: Poison. The negative must be thoroughly freed from hypo, and then immersed in No. 1 till bleached right through, then well wash and immerse in No. 2 till blackened, and again wash.

ONE SOLUTION REDUCER.

Sodium sulphite	180 grains.
Potassium ferric oxalate	½ ounce.
Distilled water to	10 "

Dissolve and add

Oxalic acid (crystals)	30 grains.

Shake till the solution turns green, then pour off from any undissolved acid and add

Sodium hyposulphite	2½ ounces.
Water, q. s. to make	20 " in all.

Label: Immerse the negative in the solution and remove just before the desired reduction is obtained, and then wash thoroughly. This solution must be kept in the dark, and can be repeatedly used, or until it turns yellow.

ONE SOLUTION REDUCER.

Potassium iodide	40 grains.
Sodium hyposulphite	2 ounces.
Distilled water to	10 "

Label: This reducer acts slowly, and may be used for plates and papers. After use the negative should be well washed.

ORDINARY NEGATIVE VARNISH.

Gum sandarac	1 ounce.
Orange shellac	½ "
Castor oil	90 minims.
Methyl alcohol	1 pint.

Allow to stand with occasional agitation till dissolved, and then filter. Label: The negative should be heated before a fire till it can be comfortably borne on the back of the hand, and then the varnish flowed over, any excess being drained off, and the negative should then be again placed near the fire to dry.

SULPHOCYANIDE TONING BATH (CONCENTRATED).

Potassium sulphocyanide	1 ounce.
Chloride of gold	15 grains.
Distilled water to	80 drachms.

Dissolve the sulphocyanide in half the water and the gold in the remainder. Mix the two solutions.

Label: This solution must be kept in the dark. Every 2 drachms of this bath contains 1 grain of gold and should be diluted with 8 ounces of water to make a normal bath that will tone about 340 square inches (equal to about twelve half plates) of P. O. P. to a warm purple. The more prints the browner the tone.

CONCENTRATED PLATINUM TONER.

Potassium chloroplatinite	15 grains.
Dilute phosphoric acid	3½ ounces.

Label: Keep in the dark. Dilute ½ ounce with ½ pint of water. Immerse the prints in a 5 per cent. solution of salt and water for five minutes; wash for five minutes, and immerse in the toning bath, and then wash thoroughly and fix in

Hypo	3 ounces.
Sodium sulphite	1 "
Sodium carbonate	½ "
Water	30 "

For black tones omit the salt bath, wash the prints for fifteen minutes, tone till brown in a borax gold bath, wash well, and then tone in the platinum bath and fix as directed above.

URANIUM INTENSIFIER.

Potassium ferricyanide (washed)	48 grains.
Uranium nitrate	48 "
Sodium acetate	48 "
Glacial acetic acid	1 ounce.
Distilled water to	10 "

Label: Poison. Immerse the well washed negative till the desired intensification is reached, rinse for five minutes and dry. This intensifier acts very strongly and should not therefore be allowed to act too long.

COLD VARNISH.

Pyroxylin	10 grains.
Amyl alcohol	1 ounce.
Amyl acetate	1 "

Allow to stand, shaking frequently till dissolved. Label: The negative should be thoroughly dry before this solution is applied, which may be done either by flowing it over the solution or with a flat brush. The negative should be placed in a warm place for at least twelve hours to thoroughly dry.

ANOTHER COLD VARNISH.

Japanese gold size,	
Benzole	equal parts.

Label: In applying this varnish great care should be taken not to use it near a light or open fire. It can be flowed over or brushed on the negative.

BLACK VARNISH.

Brunswick black	1½ ounces.
Benzole	1 "

Label: The varnish should be applied with a brush, care being taken not to use it near a light or open fire.

DEAD BLACK VARNISH.

Borax	30 grains.
Shellac	60 "
Glycerin	30 minims.
Water	2 ounces.

Boil till dissolved, filter, and add aniline black 120 grains.

Label: Apply the solution with a brush, and repeat when dry if necessary.

COMBINED TONING AND FIXING BATH.

Sodium hyposulphite	4 ounces.
Ammonium sulphocyanide	½ "
Lead nitrate	100 grains.
Alum	300 "
Distilled water to	10 ounces.

Dissolve the hypo. and sulphocyanide in 8 ounces of the water, then add the alum dissolved in 1 ounce of water, and then the lead dissolved in 1 ounce of water, boil for ten minutes, allow to cool and filter, then add 7½ grains of chloride of gold. Label: Mix the requisite quantity with an equal quantity of water. The prints should be rinsed in water for five minutes before toning.—Pharm. Jour.

GLASS BEAD MANUFACTURE AT VENICE.

THERE are more than 3,000 men employed in this industry. Formerly Venice was the only place where beads were made. It was asserted that there was no possibility of making them elsewhere owing to some climatic influence, and the chemical composition of the local sweet and salt sands. Manufactories, however, now exist in France, Bohemia and Antwerp. Some years ago a factory was also opened in India. The exportation in 1898 was 639 tons, of the total value of £144,362.

The process of making glass beads is as follows: 1. The vitreous paste is composed, and is then fused in the furnace. 2. The "canna," or long, thin, perforated tube, is made by the "Margaritai" for producing the round small globes of glass of different colors, or imitation of pearls, coral, and precious stones. 3. The rounding and working of glass pearls is done at the flame of a lamp. The first operation is considered the most important, as it provides the material necessary for making all kinds of beads, and requires some technical knowledge, and great practice, as the preparation and composition of the various pastes are still jealously kept secret.

It may, perhaps, be of interest to know something of a bead factory. The furnace contains five or six large earthen vases, divided one from the other, so that they may be differently heated, according to the various compositions which are poured into them. The operations for making the "canna farata," or long hollow tubes, to be converted into beads, and the "canna massiccia," to be reduced into pearls, are these: the vitreous paste is reduced into long glass tubes, more or less thin, according to the different thickness of the beads to be made, but in such a way that the hole in the middle of the tube is always maintained. The work is executed by the foreman, who has under his orders two assistants and four workmen, called "tiradori." One of the assistants dips the end of an iron rod, about 4 feet long, into one of the vases containing the molten paste of the required color. He then rolls it on an iron table to reduce it in a cylindrical form, and makes a round hole on the upper part of the paste. After this the foreman takes the rod in his hand and heats in the furnace the portion of paste attached to its end by giving it a few turns, and sees that the hole made is exactly in the center. He then promptly attaches another rod to the upper part of the paste. The two rods are at once delivered to two "tiradori," who, running speedily in two opposite directions, reduce the molten material into a very long thin tube, which preserves the hole in its center for all its length. The glass tubes are then divided according to their thickness, and cut in small pieces. Such pieces are then sifted and put in iron tubes with sand and coal powder, and by turning them in the furnace the pieces are made round. The pearls are then polished by placing them in a bag containing some sand and shaking them for some time. They are then separated from the sand by a sieve and put in another bag containing a portion of white bran, and again shaken, when they become extremely brilliant, and, after being sifted, are ready for sale.—Foreign Office Annual Series.

BRONZE PRINTING.

ALL classes of textile fabrics may be printed with metallic powders for decorative purposes.

Two methods of application are in use for thin goods, the ordinary cylinder machine is employed, while for thick, rough, or pile fabrics, the "Perrotine," or even hand-blocks are used.

The vehicle must be one that will so fix the powders to the material that even brushing will not remove them, also their brilliancy must not be destroyed.

Two classes of "fixers," or vehicles, are at present employed in the trade: egg or blood albumin, and various varnishes having caoutchouc as their base. As an example of the former, the following mixture may be cited: ½ gallon of gum tragacanth paste (65:1,000) and 1¼ gallons of egg albumin solution (1:1) are, when thoroughly mixed, incorporated with 8 pounds of the metallic powder, giving a total volume of nearly 2 gallons. The gum tragacanth paste and the egg albumin solution are prepared in the usual way by allowing the dry materials to soak in cold water, etc.

In using the above mixture on the cylinder machine, a lap apron is employed to furnish the color from the box to the printing roller, while for block printing, the ordinary pad suffices. This method will not answer for pile fabrics, especially if they be of silk. Before printing, the goods are slightly damped so that the paste has a better ground to hold on, and after printing they are dried without the application of heat and steamed for 15 to 30 minutes. If the fabric has been previously dyed, as is generally the case, it should be well washed before printing, which is the last operation. The paste has no effect on the dyestuffs.

The rubber paste is made from pure unvulcanized India-rubber, as the sulphur in the vulcanized rubber would injure the color of the metallic powders. The

following mixture may be used: 2 pounds of rubber and 4 pounds of camphor oil are heated together in a pan until a homogeneous mass has been obtained. After cooling to a certain extent, 1 quart of "naphtha" is added for thinning, followed by 1 pint of pure copal varnish, and the whole mixture is thoroughly stirred. After further cooling, the requisite quantity of the bronze powder is introduced and well mixed.

By the printing direct with a pale, thinned copal varnish or a good quality of gold size, and dusting on the powders, various pleasing effects are producible.

With regard to the metallic powders, there is a wide range of shades in the market, and the color mixer does not get his particular shade by mixing two powders (a method which does not give good results), but buys them direct. The colors obtainable vary from silver to reddish-brown, including yellows, greens, and blues of great brilliancy.

Other quick-drying pastes have been tried, but the solvents proved too volatile for good work.

For hand block printing, the paste used by wall-paper printers answers fairly well; although it will not withstand prolonged wear, it is useful for velvets and plushes of short pile such as are used for albums and cheap plush-covered boxes.

The main point in printing all such goods is that the impression shall be sharp, and applied with such force as shall effectually prevent the particular fibers from again rising. — Textile Colorist. Abstracted by The Journal of the Society of Chemical Industry.

WIDTH OF A LIGHTNING FLASH.

DIRECTIONS for measuring the width of bolt of lightning are not laid down in the text books! But by the aid of photography, a German astronomer has been making such measurement, and informs us that the width of a flash measured by him was "about" 5 millimeters (one-fifth inch). He tells us, further, that a flash of lightning may be widened by being literally blown along sideways by a gale—thus appearing as a broad band, or "ribbon lightning."

Mr. George Rümker, of the Hamburg Observatory, according the The Western Electrician (quoting from a German journal), obtained in August last the photograph referred to. The bolt struck a tower about one-third of a mile (500 meters) from the observatory. Knowing the distance of the tower and, consequently, of the bolt, and the focal distance of the objective of the camera, the breadth of the discharge could be calculated. The result, we are told, "closely concurs with that obtained by Piltschikoff, in Odessa, in 1895, obtained in a similar manner."

The account in The Western Electrician continues as follows:

"It is thought to be certain that the wind exercises an influence upon the form of the luminous track of the discharge. There is observed on one of the borders a line more distinct, from which there seem to detach small rays toward the opposite border. The photograph in question shows two ramifications to the right and two to the left, plainly distinguishable. The phenomenon appears like a band of silk, with the main body in a dusky light, from which shreds of the material float in the wind into the brighter light, these detachments presenting, in general, parallel curves. In the central portion of the luminous zone there is a large shaded portion, which has hitherto been unexplained, as well as the parallelism spoken of above. Each discharge of atmospheric electricity seems to have an appreciable duration, longer than discharges of laboratory electricity.

"At the instant of taking the photograph by Mr. Rümker, the wind was blowing at a speed of 14 meters a second, west-southwest, and the objective was turned to the south, so that it is possible the peculiar aspect of the discharge at this instant was due to the displacement of the column of incandescent gas which formed the principal brilliant line, under the action of the high wind, which was probably more brisk at the altitude from which the discharge came. The observatory, according to the testimony of those present, was at one moment as if surrounded by flames, yet the telephonic and telegraphic instruments were not seriously affected."

UNUSUAL ELECTRICAL MISHAPS.

THE following curious and instructive paragraphs are taken from the quarterly fire report of the Electrical Bureau of the National Board of Fire Underwriters, says The Western Electrician:

While a man was wiping an incandescent lamp with a piece of waste, the metal shade in some way caused a short-circuit, setting fire to the waste, which the man dropped to the floor, where it set fire to inflammable surroundings.

An advertising display was wired and lighted with 16-candle power incandescent lamps. About one inch of the insulation of the circuit had been removed and wires left bare for the purpose of showing the harmless power of the electrical energy by allowing people to touch the bare wires. One interested experimenter allowed the bare spots to come to contact. The flash of the short-circuit ignited the surrounding inflammable decorations and a brisk fire resulted.

While setting a steam radiator the steamfitters, in running their return pipe, bent a brass-armored conduit containing electric wires so as to make room for the return pipe, and left the two pipes in contact. In so bending it they displaced the elbow about six inches away from the point of contact, and the water from the radiator drip, which was immediately above, worked into the conduit at this opening, causing a short-circuit and a ground to the steam pipe, burning a hole in the conduit and igniting the woodwork.

In a shed a portable crane attached to trolley car was used for hoisting granite. The car was operated by a car motor placed on the underside of the car. Current supplied by 500-volt metallic circuit from overhead trolley. Some time during the night the shed was entered and current turned on the motor. The car ran up against the door of the shed and passed nearly half its length through the doorway and stopped. In that position it was left, and when discovered the insulation on the field and armature of motor was nearly burned off and the woodwork of car was burned. Damage was confined to the motor and the car. A striking employé is credited with causing the trouble.

Servants in a hotel left an incandescent lamp attached to an extension cord lying upon a bed. Heating effect of the lamp ignited the bed clothing; but fire was extinguished before any damage was done other than that to the bed.

Fire in power house due to short-circuit in power generator. At the time of trouble machine was generating about 500 amperes at 500 volts. The superintendent of the station makes the following report: "The actual trouble in the machine was a ground from the commutator to the frame. This has happened probably 100 times before in that station, and at the time this happened we had two men from the factory repairing the same kind of an accident on our other large generator. It happened in this case to be a fairly bad arc, which threw out particles of burned tape, cord, etc., setting fire to some of the insulation on the leads of the machine where they ran under the floor; also to the insulation on the armature head, which, revolving at high speed, threw some of the fire clear to the roof. The engineers report that from the time the accident happened it was not three minutes until everybody had to leave the building, two of the engineers getting severely burned in shutting down their engines. I do not think it will ever be clearly known how the fire gained such headway." The floor of this station was of wood construction laid on iron stringers, there being wheel-pits open into the basement. The revolving machinery greatly aggravated the fire.

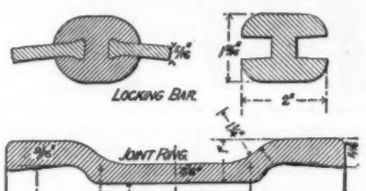
In closing a house for the winter the occupant neglected to open the service switch of the electrical equipment. Trouble developed in an insulating joint on one of the gas fixtures and arc ignited the escaping gas. A passer-by fortunately discovered the fire and prompt action saved the destruction of the residence.

COOLGARDIE, AUSTRALIA, WATER PIPE LINE.

THE Coolgardie, Australia, hydraulic enterprise, from its magnitude, has attracted universal attention, as it involves the construction and placing of 328 miles of 30-inch steel pipe, to daily deliver 5,000,000 gallons water, at an original cost of about $10,000,000.

From The Engineering Record it is learned that, as a result of the investigations of the committee, the works are now under construction.

There are some changes and modifications in the original plan. The one thing that aroused the most surprise was the recommendation that the pipe be laid upon the surface of the ground. This plan the engineers in charge propose to carry out, expecting by the special construction of the pipe to overcome the manifest difficulty because of strain, etc., occasioned by a climate where the temperatures are so extreme.



DETAILS OF PIPE JOINTS.

With a change of temperature of 75° Fahr., the amount of expansion to be provided for is about $\frac{5}{8}$ inch for every 100 feet length of pipe. But this amount was thought likely to occur only if the pipes are emptied during extremes of temperature. Special joints to allow for expansion and contraction were recommended.

In a pipe line of such extreme length the question of leakage is important. Small leaks from the joints and rivets of steel pipes, subject to strains caused by contraction and expansion, are certain to occur. If detected early, they are not difficult to repair; but below ground it was thought that individual cases would be difficult to detect. It was because of this that the engineers recommended that the pipe line be laid on the surface of the ground, thus furnishing greater facility for the inspection of the pipes and the suppression of leakage. Other reasons favoring this decision were the decreased cost and the fact that the soil along a large part of the line contains much salt. There is no prolonged frost to trouble the pipes and no difficulty is apprehended in protecting them from wanton injury.

The method of fixing the main on the surface of the ground was considered by the commission of engineers. They recommended that the pipes be supported on timber bolsters, or sleepers, the upper sides of which would be hollowed to a depth of not less than 6 inches to fit the under side of the pipe. So placed, with expansion joints every 120 feet, the pipes would offer but little resistance to motion and creeping might occur unless prevented. Also, in all curves the joints would have a tendency to move radially from the center of the curve. With a 30-inch pipe under a head of 400 feet and laid on a curve having a radius of 660 feet, the radial thrust on each length between the expansion joints is given at about nine tons. In the event of the sudden closing of a valve this pressure might be much higher. It is essential that both the tendency to creep and to move at the curves should be effectually counteracted. To prevent such movements the commission recommended flanges on the under side of the pipe to bear against piles or a mass of concrete, and piles or concrete blocks on the outer side of the pipe on curves.

The engineers recommended that the pipe line should be made up of riveted steel pipe 31 inches in diameter, made of plates $\frac{7}{16}$ inch to $\frac{1}{4}$ inch thick, and of lap-welded pipes from 26 to 29 inches in diameter. The friction head in such a pipe line is about 1,300 feet, making the total head, against which the water will have to be pumped, about 2,600 feet.

Bids were received for 246 miles of 30-inch riveted pipe and 82 miles of 26 to 29-inch welded pipe in London and Perth. The former were higher than the estimated cost; the latter were lower. The latter, however, substituted for the welded pipe a type of pipe having a patent locking bar joint, the design of M. Ferguson, of Perth. This pipe is made of steel plates fastened together with two longitudinal joints made by swelling the longitudinal edges of the plates and bringing them together in grooves made in the opposite sides of a bar. The bar is then closed onto the swollen edges of the plate by pressure.

A pipe of this kind had been previously tested by W. C. Unwin. Strips with the joint in the middle of each were cut from the pipe and tested. In five out of six tests the strips broke through the solid plate and not at the joint, while the remaining strip broke at the joint. A piece of pipe 4 feet long, 12 inches in diameter and ¼ inch thick, having two of these patent joints, was also tested by hydraulic pressure. An internal water pressure of 800 pounds per square inch was applied before the test was stopped by leakage at the ends, which had nothing to do with the construction of the pipe. Subsequently a pressure of about 850 pounds per square inch was put on before leakage again stopped the test. In a third test the pressure momentarily reached 900 pounds per square inch. The pipe was bulged, but there was no leakage at the longitudinal joints and they did not appear to be injured.

There were two bids received at Perth, one by Messrs. G. & C. Hoskins for the riveted pipe, the other by M. Ferguson for his patent locking bar pipe in place of the welded pipe. In view of the fact that the total of these two bids was considerably below the estimated cost, it was thought desirable by the chief engineer to have all the pipes 30 inches in diameter instead of some 26, 27½, and 29 inches, as specified. It was also thought desirable to have the two bidders unite and supply the whole of the pipe of the locking bar type. They were also requested to furnish a bid providing all the pipe, excepting 1,000 lengths, which were to be of plates $\frac{7}{16}$ inch thick, of plates ¼ inch instead of a portion of plates $\frac{7}{16}$ inch thick. It was estimated that the adoption of this type of pipe and the increased size would, by decreasing the friction, reduce the cost of pumping by about $50,000 per year. The total revised bid was about $5,000,000 and was still about $350,000 under the original estimate. This figure was merely for furnishing the pipe without joints or valves, and did not include any price for laying. The contract was awarded half to G. & C. Hoskins and half to M. Ferguson, and called for pipes of the locking bar type. A contract for one-half the required number of joint rings was also awarded to each bidder.

The pipes are to be furnished in lengths of 28 feet, each length to be composed of not more than two plates, and two longitudinal locking bars. The specifications require that the locking bars for the pipes made of ¼-inch pipe shall weigh not less than 6½ pounds, and those for the pipes made of $\frac{7}{16}$-inch plate not less than 7¾ pounds per linear foot, unless it is proved that such weights can be reduced without any risk of impairing the efficiency of the joint. The lengths of pipe are to be jointed together by means of the welded steel rings shown in the illustration. When considered desirable by the engineer, anchor plates consisting of three 12-inch pieces of 6×4×⅜-inch angle iron shall be double-riveted to the pipe, 3 feet from one end of every fourth length.

The specifications require that the plates and bars shall be made of open hearth acid steel, and the plates shall be capable of withstanding a tensile strain of not less than 25 nor more than 29 tons per square inch, with an elongation in 10 inches of not less than 20 per cent. and a contraction of area not less than 45 per cent. The steel must also resist the following drifting test: A hole ⅝ inch in diameter to be punched within 1¼ inches of any edge of a plate and to be drifted out, cold, to a diameter of 1⅞ inches without showing signs of fracture. Not less than two tensile tests will be made from each cast, and bending and drifting tests will be made from each plate. The pieces must bend cold around a bar of a diameter three times the thickness of the plate, without signs of fracture. The locking bar joints are to be fully as strong as the plates.

Before the longitudinal joints are made, the locking bars and the edges of the plates are completely freed from black oxide by being dipped in a bath of dilute sulphuric acid and then in a bath of lime water, followed by scrubbing, if necessary. This is done under cover and the plates and bars are not exposed to the weather after dipping, but are at once formed into pipes. The pipes are then substituted to hydraulic pressure of 400 pounds per square inch and also to smart tapping with a hammer while under pressure. After they have been tested and approved by the engineer they are dipped in the baths of dilute sulphuric acid and lime water, and when thoroughly clean are coated with a composition of asphalt and creosote. The pipes are heated uniformly to about 300° Fahr. and are dipped into the composition, which is kept fluid at a uniform temperature. They are left in the bath long enough to acquire its temperature, and after removal are suspended until the excess of coating has drained from them.

The commission of engineers recommended various valves for different points on the line. Stop valves are to be used at the inlet to each reservoir, at the outlets of the pumps, at every important depression, and generally at points not exceeding 5 miles apart. Scour valves, having openings 6 to 9 inches in diameter, are to be placed on pipes connected with the under side of the main at every depression. Back pressure valves are to be provided at the inlet to each reservoir and immediately above each pumping station. There are to be air valves at all summits on the line to liberate air when charging the main and to keep it free from air disengaged from the water flowing into it. These are to work automatically and will be placed in groups of three or four in one casing and have a considerable discharging capacity. They are to be protected by a strong cover from the possibility of interference or injury. They will also admit air to the main in case the pressure in it falls below that of the atmosphere. To prevent the air from being carried past these valves by the flow of the water, the commission recommended the provision of air domes consisting of 12-inch cast iron pipes, 18 inches in depth, with flanges fitted to the

crown of the main. Immediately above each dome should be fixed a 3-inch stop valve, and above that the air valve proper. Instead of cutting a 12-inch hole in the main, it should be perforated with numerous smaller holes. In addition to this, at the most important summits, about sixteen in number, the commission recommended enlargement of the main to about twice the normal diameter, thus forming chambers in which the velocity of the water would be reduced, and where the air or gas could freely disengage itself from the water and escape by the air valves.

There are to be eight pumping stations; one at the Greenmount reservoir, the second is a short distance from it, the others at various points along the line. On most sections of the line, it happens that there is high ground at a short distance, compared with the length of the section, from the pumping station. Up to this high ground the pumping main from each station will always be under the pressure due to the altitude and the friction. From this elevated point, however, the flow to the next pumping station will be by gravity. This portion of the pipe line will ordinarily be under the pressure due only to the elevation and the hydraulic gradient.

There is one section requiring special treatment. If the section between the second and third pumping stations were treated similarly to the rest, the closing of the stop valve at the third station would place about 36 miles of the main under a head of 450 to 650 feet. In order to reduce this head about 200 feet, a reservoir is to be built on high ground near the thirty-third mile of the line. This is to have a depth not less than 25 feet and a capacity not less than 6,000,000 gallons. The pipe line is to be broken at each pumping station by the insertion of a reservoir having a depth of at least 20 feet and a capacity not less than 2,400,000 gallons, into which the water will flow and from which it will be pumped into the next section of the line.

The location of the eight pumping stations along the line, as recommended by the commission of engineers, is such that the head, against which the water will be pumped, will be the same at each of the first four and also at each of the second four. By this arrangement there will be a great uniformity of the pumping machinery, there being but two sizes of steam engine proportioned to the two different lifts. This uniformity was considered desirable. As to the type of pumping machinery, triple expansion engines with surface condensers were recommended. Both direct acting engines without fly-wheels and engines with fly-wheels were considered suitable for pumping into the long pipe line. It was thought desirable, under the conditions in Western Australia, to sacrifice a little in economy of coal consumption, if by so doing a considerable gain in the simplicity of the engines could be obtained. Many questions regarding the pumping machinery were left to the manufacturers who might present bids for the same. Each station is to have a reserve for use in case of accident.

At present the excavation for the foundation of the dam on the Helena River, amounting to 50,000 or 60,000 cubic yards has been completed. The delivery of the pipe under contract has begun. Bids for supplying the pumping machinery to the extent of about 6,000 horse power, which is about double the amount required for daily work, have been received. This work is being carried out under the direction of the Public Works department of Western Australia. The total cost of the project is estimated to be about $12,000,000.

At Coolgardie there is to be a service reservoir having a capacity of at least 24,000,000 gallons. In the future it may be necessary to construct another reservoir about 4½ miles from this one and 170 feet higher. An additional pumping station will be required for this, but both this reservoir and pumping station have been left for the future and are not included in the present project. A number of smaller service reservoirs at points along the line were included in the project, as were also 100 miles of 12-inch distributing mains at Coolgardie.

The difference in level between the Greenmount reservoir and the service reservoir at Coolgardie will be about 1,300 feet, and it was assumed by the commission of engineers that the whole of the water would be pumped to this height.

MOVING A BRIDGE.

NOT long ago, says the Centralblatt der Bauverwaltung, it became necessary to demolish the single-track tunnel of Heinitz constructed upon the mining line between the last named place and Neunkirchen. Some subsidences that had occurred in the mine had reduced the section of the tunnel in a threatening manner, so that it had become necessary to replace the latter by a cutting. But, before the end of the work of demolition, a lattice girder bridge 108 feet in length had to be established 66 feet above the tunnel and obliquely to its axis, in order to give passage to the road from Bildstock to Neunkirchen. Unfortunately, during the work of excavation, a crack formed in the rock that supported the abutments of the bridge, and this would have caused a caving-in of the whole work had the demolition of the remaining part of the tunnel been finished.

No delay was permissable, and it was decided that the bridge should be reestablished 98 feet further along upon new abutments constructed upon ground that was perfectly safe. To do this, the engineers resolved to move the bridge in a single piece. The operation was so much the bolder in that the bridge was not to be displaced at right angles with its longitudinal axis. In consequence of the position of the reconstructed abutments, it was necessary to turn this axis, and the distances that the two extremities of the bridge had to be moved were not identical. The solution, which was not very easy to put in practice, consisted in placing under each extremity of the bridge a single car provided with a movable platform.

In the first place, two tracks had to be laid for the cars to run upon; but, as regards this, a difficulty presented itself at the very outset. Between the old position of the bridge and the new site, the earth that covered the tunnel had been removed in the process of making the cutting, and, since the tracks could not be placed directly upon the ground, they had to be installed upon a scaffolding about 33 feet in height. This scaffolding was carefully crossbraced in order that the horizontal pressures should be balanced, and, at the same time, the tunnel was timbered, or at least that part of it that remained absolutely incapable of resisting the least stress. The tracks were of the normal gauge and formed of ordinary rails laid upon wooden ties, which rested upon two wooden sleepers spaced 5 feet apart. The scaffolding, properly so-called, consisted of trestles spaced, on an average, 34·5 feet apart. In order to facilitate carriage, the track was given a slight slope of $\frac{1}{15}$ in the direction of the displacement.

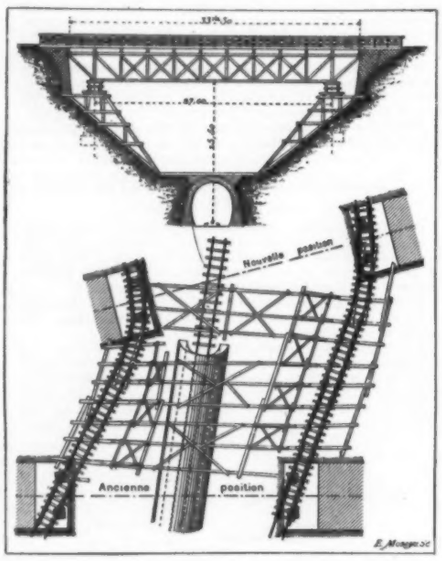


FIG. 2.—ARRANGEMENT OF THE SCAFFOLDING AND PLAN OF THE TRACKS, SHOWING OLD AND NEW POSITIONS.

In order to begin the operation of displacement, the metallic part of the bridge, weighing seventy tons, was first raised by means of jacks, and was afterward allowed to rest, through the intermedium of a special scaffolding, upon each of the movable platforms carried by an iron car provided with wheels 32 inches in diameter. Each extremity of the bridge was provided with an iron support with which the pivot of the platform was capable to engaging. To the two cars were fixed steel cables stretched by windlasses placed at a distance of about 328 feet. Moreover, to the rear of each car was hooked another steel cable that wound round a strong post, and unwound in measure as the bridge moved forward. In this way, it was possible to arrest the motion at any moment. During the displacement, it became necessary to measure the motion of each extremity of the bridge, in order that the two cars should always remain exactly at the same distance. To this effect, one of the rails of each of the tracks was provided with proper datum marks.

The preliminary preparations, which were entrusted to the Jucho establishment of Dortmund, occupied eight weeks. After the displacement of the bridge began, the operation proceeded at the rate of 3·28 feet a minute. One slight accident occurred: a badly squared sleeper broke, and the cable of one of the cars parted in the final curve of the journey. This was repaired in three hours, and by night the whole work was successfully finished.—For the above particulars and the engravings we are indebted to La Nature.

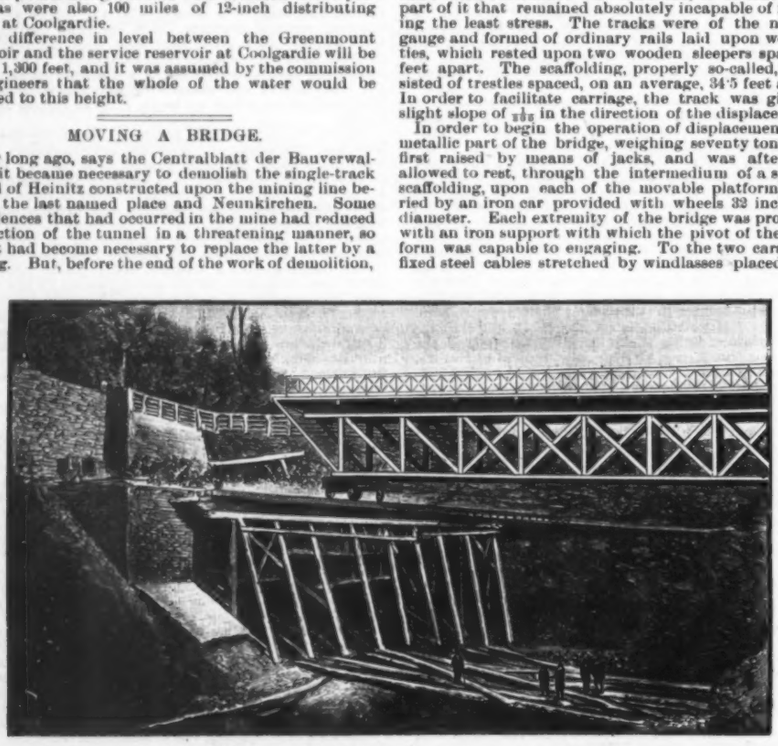


FIG. 1.—THE BRIDGE LEAVING ITS ORIGINAL POSITION.

REGULATIONS CONCERNING THE PRIZE OFFERED BY THE AERO CLUB.

M. HENRY DEUTSCH (DE LA MEURTHE), after some conferences held with Count de La Valette and the Administrative Council of the Aero Club, has addressed the following letter to Count De Dion, president of the society:

MR. PRESIDENT:

Desirous of contributing to the solution of the question of aerial locomotion, I promise to place at the disposal of the Aero Club a sum of one hundred thousand francs to constitute what shall be called the "Aero Club Prize," and that shall be awarded to the experimenter who, starting from the Park of Aerostation, the hills of Longchamps, or any other point situated at an equal distance from the Eiffel Tower, shall, in half an hour, have doubled the said tower, and have returned and landed at the starting point.

The competition for the winning of such prize shall be international; and I point out merely the broad lines thereof.

Every year, at epochs that shall be appointed, the authors of projects that have been accepted shall be permitted to make a practical trial of their apparatus.

Such apparatus (balloons or flying machines) shall be established, be put in a state of service or be actuated by the competitors at their own expense, risk and peril.

If it is decided that one of the contestants has fulfilled the programme prescribed, the prize shall be awarded to him, and I shall immediately pay the sum of one hundred thousand francs into the hands of the president of the committee of the Aero Club.

If, in the same contest, the programme prescribed is fulfilled by several experimenters, the prize shall be divided among them, in making allowance for the time spent in the execution of the programme.

The committee of the Aero Club alone shall be judge of the competition. It shall establish regulations that shall be published and in which it shall fix the method of transmitting the projects, the date and the order of the trials, and the conferring and division of the prize.

Its decisions shall be final, and shall not be subject to any appeal whatever for any cause whatever. The competitors, by the fact that they take part in the competition, shall be obliged to accept the decisions of the committee.

If the prize is not awarded within a period of five years, beginning with April 15, 1900, my agreement shall be annulled.

During this period, and so long as the prize has not been conferred, I shall annually place in the hands of the committee of the Aero Club the sum of four thousand francs, which it shall distribute, as it shall judge proper, to such experimenters as may seem to it to merit encouragement.

HENRY DEUTSCH (DE LA MEURTHE).

4 Place des Etats Unis, Paris, March 24, 1900.

The committee of the Aero Club assembled on March 24th, under the presidency of Count Henry de La Vaulx, received this letter, and, after accepting M. Deutsch's offer, decided to request the Commission of Scientific Aerostation to organize the competition and be the jury on the "Grand Prix" of the Aero Club. The Commission assembled April 2d, under the presidency of Prince Roland Bonaparte, accepted the mission offered it by the committee of the Aero Club and appointed a sub-commission composed of M. Cailletet of the Institute, Count Henry de La Vaulx, Count Castillon de Saint Victor, Count de la Baume Pluvinel and M. Emmanuel Aimé, for the purpose of drawing up regulations for the competition.

This sub-commission elected M. Henry Deutsch as a fellow member. The sub-commission assembled April 7th, at the office of the secretary of the Aero Club, under the presidency of M. Cailletet, established the following regulations, which were approved by the Commission at its session of April 9th:

ARTICLE FIRST.—The competition for the Grand Prix of the Aero Club shall be open every year from the 1st to the 15th of June and from the 15th to the 30th of September, in 1900, 1901, 1902, 1903 and 1904, until the prize has been won. If occasion requires it, the last period of the competition shall open on the 1st of April, 1905, and finish at the extreme limit designated by the founder of the prize, viz., on the 15th of April, 1905.

ARTICLE SECOND.—In order that they may take part in the trials, the competitors must sign their names at the office of the general secretary of the Aero Club, 48 Rue du Colisée, at least two weeks before the opening of each period.

ARTICLE THIRD.—The signing of the name shall not be valid until after acceptance by the Commission, which shall have the apparatus presented for competition examined by its agents, without, however, assuming any responsibility whatever, as stated in Article Eleventh. The signature must be accompanied with a fee of fifty francs, renewable at each period of the competition during which the experimenter is permitted to make his trials.

ARTICLE FOURTH.—The starts, unless other arrangements shall be made, shall take place from the Park of Aerostation, located at Saint Cloud (Longchamps hills on the left bank of the Seine, in proximity to the Aqueduct of the water of the Avre). They shall take

place between 6 o'clock in the morning and 6 in the afternoon. The round trip is about 6·6 miles.

ARTICLE FIFTH.—Each experimenter, during each period, may make as many trials as he desires. He must, however, make sure personally of an official verification by notifying each of the members of the Commission of Aerostation by telegraph at least twenty-four hours before he starts from the Park. Instructions shall be given him to this effect at the time that his signature is taken.

ARTICLE SIXTH.—The conditions of the trial are exactly defined by the Commission as follows:

The start shall be made from the Park of Aerostation of the Aero Club, or from some other place in the vicinity that may be designated; a curve closed in such a way that the axis of the Eiffel Tower shall be in the interior of the circuit shall be described without touching earth, and by the only means that are on board; and a return shall be made to the starting point within a maximum length of time of half an hour.

ARTICLE SEVENTH.—At the end of any period whatever of the competition, if the conditions of the programme have been fulfilled, the prize of one hundred thousand francs shall be immediately awarded by the jury and paid by the treasurer of the Aero Club at 48 Rue du Colisée.

ARTICLE EIGHTH.—If, during the course of a period, several competitors have complied with the conditions prescribed, the prize shall be divided among them by fractions inversely proportional to the time employed in effecting the trip, conformably to the following formulas:

If two competitors make the trip respectively in a and b minutes, the portions Xa and Yb coming to each will be expressed thus:

$$Xa = \frac{100{,}000\,b}{a+b}$$

$$Yb = \frac{100{,}000\,a}{a+b}$$

If three competitors make the trip in a, b and c minutes, the portions Xa, Yb and Zc coming to each will be expressed thus:

$$Xa = \frac{100{,}000\,bc}{ab+ac+bc}$$

$$Yb = \frac{100{,}000\,ac}{ab+ac+bc}$$

$$Zc = \frac{100{,}000\,ab}{ab+ac+bc}$$

The evident law of these formulas leads to the following general statement:

Say that there are n competitors who have satisfied the conditions of the programme within the maximum time of 30 minutes, then the share coming to each one of them will be expressed by a fraction having for its numerator the number 100,000 multiplied by the product of the times of the $n-1$ other competitors, and for its denominator a sum formed of n parts, each resulting from the product of $n-1$ times taken $n-1$ by $n-1$.

ARTICLE NINTH.—On the 15th of April of each year, if the prize has not been won, the Commission may award, wholly or in part, the four thousand francs interest to experimenters whose trials appear to it to be worthy of encouragement.

ARTICLE TENTH.—From the decisions of the Commission there is no appeal. The competitors, by the very fact of their registering, agree to accept them as well as to comply with the present regulations and to the ulterior modifications that the Commission may make therein, especially as regards the details of the organization of the competition.

ARTICLE ELEVENTH.—Civil and penal responsibilities must be borne by the competitors upon whom they fall. The Aero Club declines to assume any responsibility of whatever nature it may be.

THE CUTTING OF DIAMONDS AT AMSTERDAM AND THE WAR OF THE TRANSVAAL.

ALTHOUGH the connection between the two is not apparent at first sight, it is really very close. It cannot be too often asserted that war is not a scourge striking only those who engage in it. To-day the different parts of the world are so closely bound together by commercial and industrial ties that a crisis of this kind reacts violently on countries having trade relations with either of the belligerants, and those who are employed in one occupation or another are stricken down from failure in the reception of the rough material of their handicraft.

This is what has happened to the lapidaries of Amsterdam. The rough diamonds cut in the celebrated workshops of that city come from Brazil or the Cape, especially from the Cape, whose stones have almost driven from the market those of South America. But the diamonds of Kimberley are not now to be had, and the workers are in such straits that measures for their relief are necessary.*

We recall the fact that at the end of the sixteenth century the cutting of facets on the precious stone was familiar at Amsterdam, and that the knowledge extended to Antwerp and Paris, the only localities where there is serious competition with the Amsterdam lapidaries. The Kohinoor, weighing 279 carats, was cut by a Dutchman. It was about 1820 that diamond cutting was really developed as a noticeable industry of Holland, and it reached its apogee from 1873 to 1885, the exact time when immense quantities of diamonds arrived from the Cape, and the plan had not been adopted of limiting the supply on the market to prevent the breaking of prices. Since 1885 the cutting of diamonds has been affected very unfavorably, yet it still occupies an important place at Amsterdam.

Without taking into account some secondary establishments at Rotterdam and Hilversum, at the end of 1898 Amsterdam numbered fifty houses of the first rank, having 7,200 steam grinding stones, and employing in polishing and in the cutting or cleavage 11,000 work people, of whom 600 were women. An interesting fact not generally known is that the proprietors of the shops let the apparatus only to workmen operating for the jewelers. The annual production, notwithstanding the great falling off since 1875, amounts to fifty millions of florins, and is almost entirely exported. The expense of the hand work, that is, the wages of those now thrown out of employment, amounts to some fifteen or sixteen millions of florins.—La Nature.

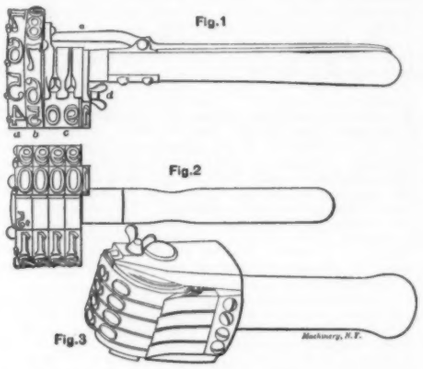
* The re-opening of the mines at Kimberley will doubtless soon restore diamond cutting to its former state at Amsterdam and elsewhere.

NUMBERING HAMMER.

By ROBERT GRIMSHAW.

IN the forest and lumber yards of Germany and Austria there is used a style hammer for marking logs and boards with consecutive numbers, which might prove advantageous to pattern shops for marking patterns, and in shipping departments of large manufacturing establishments sending out great quantities of small cases.

The first style has a head with two number-wheels,



each bearing digits 0 to 9 inclusive. The thousands, tens of thousands and hundreds of thousands not being so often changed, are not on wheels but on separate pieces, *C*, which are changed as often as necessary by removing the thumb nut, *D*. Pressing on the latch, *E*, which lies along the handle, permits turning the wheels, *a*, *b*. This device numbers up to 19,999. Common printink is used. The numbers are about an inch high, and are deeply and sharply cut at their edges so as not to require great force to make a deep, sharp impression.

A simpler contrivance is shown in Fig. 2, which has four wheels and numbers up to 19,999, and a stationary "1," and will also print a decimal fraction 0·5 at a separate blow.

Both these hammers permit of a heavy blow and make a deep impression. Where, however, it is required to make but a light impression, or to make either a light or a very hard blow in a particular place and with greater regard to the direction in which the numbers lie, the four-wheel punch style shown in Fig. 3 is used.

This has a figure of the one hundred thousands, which may be rolled into place and held there when desired; the other numbers are on wheels held by a latch. There is, so far as I know, no patent on the first two styles; on the third only one German "Geschutz Muster" protection.

I suggest that the first may be improved by the addition of a back head, which would not only give greater force to the blow, but permit the use of the tool on very hard woods and in confined places where great exactitude of position is necessary, as it may be placed on the spot where it is desired to number and be struck with a mallet.—We are indebted to Machinery for our engraving and the foregoing particulars.

Destruction of Ships by Spontaneous Combustion.—Recent investigations on the spontaneous combustion of coal in ships, according to the Revue Scientifique, says The Literary Digest, show that, contrary to general opinion, ventilation does not help the matter, for plenty of well ventilated vessels have perished in this way. Coal should be as large as possible, and should contain no pyrites, which often start the combustion. Humidity is also dangerous, and should never exceed 3 per cent. Some kinds of coal, such as cannel coal, are peculiarly inflammable and should never be carried on shipboard. Water and air are best entirely excluded, for in the complete absence of both spontaneous combustion could not occur. The actual cause of the action is oxidation, which generally begins with the included pyrites, and temperature thus being raised, spreads to the coal.

RAILROADS IN ASIA.

FROM different reliable German newspapers I have gathered the following information with reference to railroads in Asia.

The lines now in existence have a total length of about 30,000 miles, of which two-thirds belong to British India. The portions of the Trans-Caspian and Trans-Siberian railways already constructed have a length of 3,200 miles. A number of European syndicates have obtained concessions for 3,600 miles of railroads in China, which will traverse regions rich in minerals and agriculture; many of these lines are already in process of construction. The Chinese Government owns about 300 miles of railway. The lines are very remunerative, especially that from Pekin to Tientsen. Japan is well provided with railroads; the present length being 3,200 miles. French Indo-China has at present only 120 miles, but the French possessions in Cochin-China, Anam, and Tonkin will soon have 2,400 miles, which will greatly help to develop their mineral and agricultural resources. The Dutch Indies are well supplied. Java alone has 1,000 miles. There are as yet no railroads in Persia of any consequence; but Turkey operates 1,500 miles in Asia, and 600 miles more are in construction or projected.

The Russian commission, which for months past has been busy with the preliminaries for the construction of a railroad from Astrakhan up the River Volga, has completed its labors. The plan is to lay the track on the left shore of the Volga and to connect with the general Russian railway system. This railroad will become of the utmost importance for the whole commerce of Russia with central Asia and Persia—the more so because, at the same time, the Volga channel through the Caspian Sea will be deepened to enable steamers to proceed directly to Astrakhan without being compelled to reload on flat-bottomed lighters.

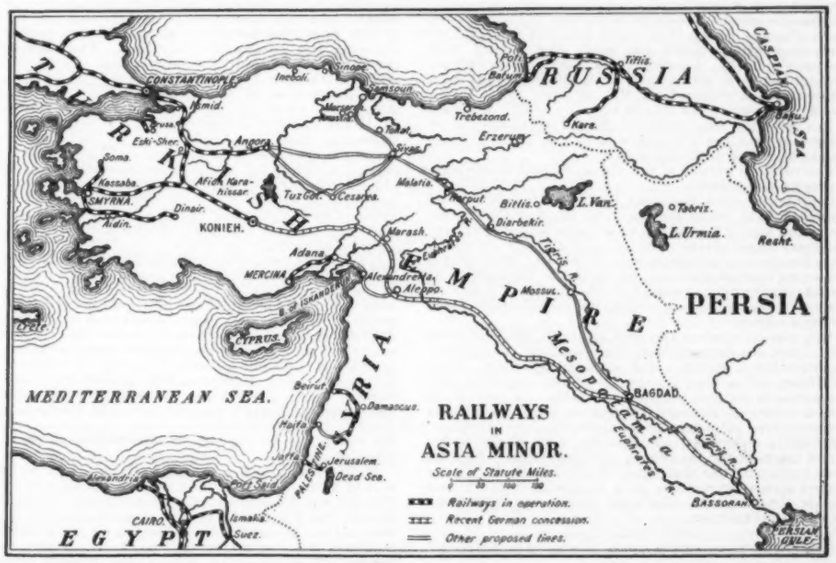
RICHARD GUENTHER, Consul-General.

Frankfort, January 25, 1900.

RAILROAD CONSTRUCTION IN ASIA MINOR.

THE newspapers report that the controversy in regard to railroad construction in Asia Minor has been settled for the present by a concession granted to the Anatolia Railway Company. This German company, it is understood, will extend its present line, which terminates at Konieh, via Marash and Bagdad to Bassorah. The opposition of the French company owning the Smyrna-Kassaba road, which extends east as far as Afion Karahissar, was removed by granting this company 40 per cent. of the shares in the extension, and the local objection was obviated by a provision in the concession giving the Turkish Government the right to purchase the line at any time.

Few railroad lines can be of greater prospective importance than this 2,000 miles of railroad uniting the Persian Gulf with Europe, forming a rapid transit to and from the East, opening up large tracts of agricultural country, and paving the way for German commercial supremacy in Asia Minor and Mesopotamia.



It is not difficult to see how Germany, with preferential rates for goods on German lines, will be able to control the chief markets of Asia Minor and invade the East. A reference to the accompanying map will show how Germany is acquiring commercial supremacy in Asia Minor. Germans purchased the Constantinople-Ismid Railroad from an English company and extended it to Angora. They also checkmated the French and English by extending their line from Eski-Sher to Konieh, thus preventing extension of both the Smyrna-Afion Karahissar and the Smyrna-Aidin-Dinair roads.

The two great distributing points—Constantinople and Smyrna—are thus controlled by Germans, and German goods may enter the interior of Asia Minor and the great valley of the Tigris and Euphrates on German-controlled roads at a decided advantage.

Germans have obtained the right to build docks and warhouses at Haida Pasha, the terminus of the Anatolian railroads; and with through rates for German goods on German lines, German freight cars may be sent across the Bosphorus and travel to Mesopotamia and the confines of India and Persia without change. Goods from the United States and other countries will have to be transhipped at Constantinople or Smyrna, and will be consequently at a disadvantage.

But water transport is always, mile for mile, cheaper than rail transport, and I see but one scheme of competition left for the United States in Mesopotamia and southern Anatolia. Let the proposed line from Samsoun (or Sinope) to Sivas, Diarbekir, and Bagdad be built, and a country vastly superior in agricultural products will be opened up, giving more local traffic than the German line from Konieh to Bagdad, which must traverse a barren and sparsely inhabited land.

MILO A. JEWETT, Consul.

Sivas, December 27, 1899.

THE PRODUCTS OF THE INCINERATION OF TOBACCO, AS IN SMOKING A CIGAR.

H. THOMS, in a paper recently published in the Apotheker Zeitung, translated by The National Druggist, on the products resulting from burning tobacco (as in the smoke of a cigar), comes to the following conclusions:

"The smoke of tobacco contains the following deleterious, not to say dangerous elements: Nicotin, pyridine and its homologues, and a certain empyreumatic oil. He was unable to detect hydrocyanic acid (which has been declared to be present by others).

"A curious fact is that the bottom of the pipe or receptacle prepared in the apparatus for this purpose, was found to contain a quantity of nicotin from two to three times greater than that derivable from the tobacco direct by processes other than burning.

"The pyridic bases are derived from the decomposition of nicotin, about 75 per cent. of the nicotin passing over as that substance, while the residue, or 25 per cent., is decomposed, giving rise to these bases.

"The determination of its nicotin percentage is no criterion as to the value of a specimen of tobacco. As in the case of tea, coffee, cognac, etc., the sole criterions, in this direction, must be the gustatory organs of the expert connoisseur."

In his experiments, made with the view of discovering, if possible, some new method of determining the value of any given specimen of tobacco, M. Thoms determined the proportions of the principal elements of tobacco smoke. He determined, first, the quantity of nicotin that a tobacco of a known and definite composition gives off, as such, with the smoke, as well as the amount that passes off by decomposition into pyridic bases; second, the amount of carbonous residue, ash and its composition; third, the amount of carbonic oxide; fourth, amount of empyreumatic oil; fifth, the amount of hydrocyanic acid.

The apparatus used by the author was especially constructed for him. It consisted of a tube for holding a cigar, with a receptacle beneath, for catching the ash. This tube (analogous to the mouthpiece or "cigar holder") is ultimately connected with a draught tube, itself attached to a hydrant in such manner that when the water is allowed to flow the stream produces an uniform draught, by which the smoke and gases arising from combustion are drawn through, first, two flasks, each containing a 10 per cent. aqueous solution of caustic soda, which take up the carbonic, butyric and hydrocyanic acids (if the latter be present, though thus far only insignificant traces have been detected). Thence the smoke passes consecutively through three flasks charged with a 10 per cent. solution of sulphuric acid, and which retain the acids, the nicotin and the pyridic bases. Leaving these, the smoke is carried through a flask containing fresh defibromated and filtered blood, which fixes the carbonic oxide. The last flask contains dry cotton lint, the object of which is to absorb the empyreumatic oil. The draught is arranged so that it will consume from five-sixths to nine-tenths of a cigar in 30 minutes.

The residual nicotin of the stump or butt of the cigar is determined directly.

In practice, after the cigar is burned to the desired point, a steam jet is thrown into the first two flasks, by which means the dissolved alkalies are carried into the next three flasks. The mixed alkaline solutions are extracted by agitation with ether, and, after acidulation with sulphuric acid, submitted to distillation. If hydrocyanic acid be present in the distillate, it will be shown by the usual test, and by its transformation into Prussian blue.

In a similar manner the acid solutions are exhausted with the ether derived from the preceding distillation, then rendered alkaline, and leached by steam. The distillate, containing the pyridic bases, nicotine and ammonia, is acidified with acetic acid. A current of steam is carried through to remove pyridine and its homologues. The residue is again rendered alkaline, and again submitted to leaching with steam, to remove traces of the alkalies, a fact evidenced when the last portion of the distillate, acidified with H_2SO_4, no longer give a precipitate with iodide of bismuth and iodide of potassium. The total results are determined in the usual manner.

PHILIPPINE WEIGHTS AND MEASURES.

"THE French consul at Manila in a recent report gives an explanation of some of the chief features of the complicated system of weights and measures in use in the Philippine Islands. The unit of weight for hemp, sugar, copra, and grain is the 'picul,' which is equivalent to 139·4674 pounds, United States standard, and the 'picul' is divided into 100 'cates,'" says the Manufacturer. "Grain is also sold by dry measure. The standard is the 'cavan,' which is equivalent to 68·1 United States quarts or 2·13 bushels. The 'cavan' is made up of twenty-five 'gantas' (2·724 quarts each), which in turn contain eight 'chupas' (22·88 cubic inches each) of four 'aptanes' each (5·644 cubic inches in each 'aptan'). Tobacco and ramie are sold by the 'quintal,' in bales of two, three or four 'quintals' each. The 'quintal' is equivalent to 101·41 pounds, and is divided into four 'arrobes' of 25·35 pounds. Oil sells in 'tinajas' or jars of sixteen 'gantas' each, the 'tinaja' holding about 50·71 quarts and the 'ganta' being equivalent to 3·17 quarts. Indigo is sold in three grades, the standard being a 'case' or 'chest.' The case of the first quality contains from 771·61 pounds to 881·84 pounds, the second quality case from 661·38 pounds to 771·61 pounds, and the third quality from 440·92 pounds to 551·15 pounds."

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Cotton Production in Africa and Asia.—The arrival in France of several small lots of cotton grown in the French Soudan has excited a great deal of comment among French capitalists, especially among the leaders in colonial work. Specimens of this cotton were displayed at a recent meeting of the National Agricultural Society. There were present a number of manufacturers of cotton goods—some from other countries—and all manifested a keen interest in the subject. The principal speaker was Mybowski, a French explorer, who has spent a great many years in Africa and is considered an authority on that country. I translate and condense briefly from his remarks, says United States Consul John C. Covert, of Lyons.

"The progress of the production and the manufacture of cotton is calculated to inspire wonder. A century ago England was the only market to which the world looked for its supply. In 1784, England received the first shipment of 71 bales from the United States. The quantity seemed enormous. English customs officials could not believe that it came from the New World and seized it on the ground of a false declaration of origin. To-day, Uncle Sam produces 10,000,000 and 12,000,000 bales—over 3,000,000,000 pounds. In spite of the impulse to manufacture given by machinery, perfection has not yet been reached. The quality of cotton necessary to receive a uniform dye is still to be produced. The Nogent Colonial Garden has undertaken to improve existing plants through scientific selection, to the end that our colonies may be provided with better seed.

"We possess immense areas in Africa where the cotton plant grows as luxuriantly as wheat in the most favored plains of France. To emancipate ourselves from England, which holds, as it were, an exclusive control of this textile, it is only necessary for us to systematize this branch of agriculture in the Soudan, Congo, Senegal, and the Upper Oubangi. The climate is most favorable, thanks to the strongly marked alternations of dry and wet seasons.

"The cultivation should be modified, not by the introduction of American cotton, which thrives indifferently there, but by an improvement of existing local varieties. Our commercial interests know what African cotton is. Thirty tons of it have already arrived here from the Soudan. Fifty tons more are about to be shipped. It is coarse, but that is because it was gathered by the natives from plants over a year old. It should be planted yearly, which can be done by the system of rotation of crops, if deemed necessary. Cotton is like tomatoes; these two plants may live several years, but the first year's products are the only really good ones.

"The best crops of American cotton present striking inequalities, which up to this time seem to have escaped the attention of experts. These differences extend even to the seeds in the same capsules, which may have a good, bad, or indifferent poil. To make a judicious selection, it is necessary to study, one by one, the "silks on the crests." The failure to make this careful study accounts for the inability of the trade to furnish sufficiently uniform cotton. In order to estimate the value of each fiber (poil), its diameter, length, and resistance must be determined. The longer, the finer, the more silken, and the more snarled the poil, the greater its resistance. The diameter is measured by the aid of a microscope. To be of good quality, it ought not to exceed twenty or twenty-one one-thousandths of a millimeter. The resistance is determined by a very ingenious apparatus invented by M. Henri, of the Colonial Garden. It ought to be between six and nine grammes. By applying these methods, the savants at the Nogent Garden have succeeded in obtaining the best seeds, which are sent to the colonies for propagation. There is every reason to believe that cotton will soon become a powerful element of wealth for our colonies, and that its culture will be placed in a flourishing condition by the interposition of private enterprise.

"The total production of Russian cotton, up to within a few years, has hardly reached half of the total yield of the United States. The output of India does not exceed 3,000,000 bales, and that of Japan is hardly 300,000 pounds. Within a few years, however, Russia has been striving to create an important cotton center in Turkestan, and she expects to secure raw material from that quarter in sufficient quantity to supply the mills of the metropolis. It is difficult at first glance to explain the success here; the climate is severe, the extremes of temperature marked, rain is rare, and the heat is intense. But the extreme warmth of summer intensifies the power of vegetation, and irrigation takes the place of rain."

M. Cornue, another speaker, stated that while he was in Moscow he saw many wagons loaded down with cotton from Turkestan. He thought that in the near future, the Empire of the Czars could supply the full demand of the metropolis. The Russians believe than within a few years they will begin exporting cotton goods. The raising of cotton has already created great activity in all the trans-Caspian country.

Gold in Quantung Peninsula.—It was recently published that an engineer had discovered unusually rich gold mines in the Quantung Peninsula, and that Port Arthur itself stood on ground unusually rich in auriferous deposits. It may now be said that all such reports are greatly exaggerated, and this particular officer found no gold at all; only some quartz, whose gold-bearing qualities are yet to be tested, says R. T. Greener, commercial agent at Vladivostock.

The mining engineer, Bagdanovich, sent to Quantung by the Ministry of Government Land and Property, has prospected in that region, but the results are not as yet officially published. It is known here, however, what some of his conclusions are. He proved the presence of gold in three qualities—beach sea, placer land, and quartz in veins. In the last, he found visible ledges of quartz containing free gold. In the gold sand of the first quality were found separate parts of the precious metal or nuggets. In the gold sand of the sea mining, 8 miles from Port Arthur, a gold nugget weighing one-fourth of a pound was found by three Chinese workmen; but they prudently divided the nugget into three pieces and disappeared in as many directions.

It is rather early to say anything definite, but there is no doubt that there is gold in the Quantung, for the administration has taken the precaution to establish a strict guard, and has prohibited mining until further orders are received from the Ministry of Agriculture and Government Property.

Prevention of Railway Accidents in Russia.—Experiments have been made at Vershbolovo station, on the St. Petersburg and Warsaw road, with an invention of Mr. Nikolaieff, designed both to give warning and to lessen the deadly effects of railroad collisions, says R. T. Greener commercial agent at Vladivostock. Two wrecking railroads were provided—on the first, the sleepers were displaced; on the second, the rails were displaced. In both cases the stoppage was immediate by the aid of this device, without outside assistance and without injury to the moving trains. The essential feature of the invention is an iron tube of usual construction, connected with the general system of brakes and placed in front of the wheels. At the least irregularity in the movement of the train, the tube, in consequence of certain cuts made on it at intervals, breaks, and thus produces an immediate stoppage of the train, locomotive as well. The examining committee found that the tube fully accomplished its purpose. Such an invention is of the greatest importance in Russia, where railroad accidents are a common occurrence. According to the official statistics published by the department of railways, the number of fatal railway accidents in 1893 was 4,548; in 1895, 5,763; in 1896, 6,107.

Petroleum Discovery in Egypt.—Consul-General Long writes from Cairo, March 14, 1900:

I have to report the discovery of petroleum on the Nile, as the result of recent experiments in borings by a syndicate composed of American, English, and Egyptian capitalists, at the head of which is Sir Elwin Palmer, upon whom I called yesterday for detailed information. This gentleman, while admitting the discovery of oil, informed me that he could not furnish data at the present time, but hoped to be able to do so within the next two or three months, upon the receipt of which I will report further.

Stenographic Typewriter in Germany.—Under date of March 9, 1900, Consul-General Guenther, of Frankfort, says:

Although typewriters for shorthand have been patented, the drawback has been that they wrote upon narrow paper, like a printing telegraph. A stenotyper, invented in Germany, employs a roll of paper equal in width to an ordinary shorthand notebook. The operator has six keys to tap upon, as against thirty or more on an ordinary typewriter. To read stenotype, the eye must become accustomed to a new style of type, based somewhat upon the Morse alphabet in telegraphy, as it consists of a combination of dots and dashes. The marks of the six keys, which can be tapped simultaneously, can be combined in sixty-three different ways, producing an alphabet of sixty-three letters.

Cotton Seed Oil in Mexico.—The following, dated March, 28, 1900, has been received from Consul Griffith, of Matamoros:

The average annual production of cotton seed oil in Mexico during the past few years has been about 1,500,000 kilogrammes (3,306,900 pounds), and the consumption last year, as near as can be determined, was 14,000,000 kilogrammes (30,864,400 pounds). The price has averaged about 25 cents per kilogramme. Inasmuch as the crop of Mexico, as well as in the United States, has been below the average and there is a strong probability owing to the scarcity of rainfall in the cotton-growing sections of Mexico of another short crop, the prospects for the oil trade during the coming year are bright. In the manufacture of soap, this oil has no competitor; but both the castor bean and the coyol, on account of their hardiness, may be cultivated in such quantities in the near future as to affect the market. In fact, some of the latest improved machinery for crushing the oil from the castor bean has recently been purchased and will be used to refit a plant near Durango, which has been in operation for two years with unsatisfactory apparatus. The coyol, which flourishes luxuriantly without cultivation throughout the tropics, is a shrub or species of palm upon which grow bunches of berries. These berries, as they contain 80 per cent. of oil, are of inestimable service in the manufacture of soap; but they are said to contain too much acid to render them valuable for lubricating purposes.

A New Greek Railway.—Consul Skinner sends the following from Marseilles, April 7, 1900:

A French financial review says M. Theotokis, Prime Minister of Greece, has signed a convention with the representative of the syndicate of construction for the Oriental Railway, for the building of a railroad to connect Piræus and Thessaly, and to continue to the Turkish frontier. The railway will necessitate a loan of 43,750,000 francs ($8,299,000), which will be contracted by the government at 4 per cent.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS

No. 723. May 7.—Electric Railway and Lighting in Vladivostock—The Siberian Railway—*Gold in Quantung Peninsula—*Prevention of Railway Accidents in Russia—*Cotton Production in Africa and Asia.

No. 724. May 8.—German Trade in South Africa—*Wagon Factory in Chemnitz—Scarcity of Paper and Increased Prices in France—Land Ownership in Japanese Settlements in Korea—Automobile Exposition at Nuremberg.

No. 725. May 9.—Possibilities of the Chinese Market.

No. 726. May 10.—Regulations of Flour Trade at Malta—Proposed Bridge at Sydney—Production of Wine Abroad—Quinine Auction at Batavia.

No. 727. May 11.—Food Adulteration in Europe—*Advertising American Exhibits at Paris.

No. 728. May 12.—Trade of Vladivostock—Dredging of Port at Valencia—Automobiles in Germany—German Printing Machinery in Porto Rico—*Arsenic in German Fabrics—*A New Greek Railway.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Latrine Oil.—Heat 250 kilos. of colophony and 750 kilos. of heavy coal-tar oil, with stirring in an iron kettle to a complete dissolution.

This latrine oil is poured into the toilet pits and barrels, whereby the odor even in the hot season is almost entirely obviated. For one pit 2 kilos. of latrine oil is sufficient.—Seifensieder Zeitung.

Silvering Powder for Copper.—Rub up 30 grammes of boiler scale, 13 grammes of potassium cyanide and 8 grammes of lunar caustic into a very fine powder and preserve in well closed flasks. For use, a little cotton wadding is saturated with water, dipped in the powder and the piece to be silvered is rubbed with it. Same must be cleaned well previously. Finally it is washed in hot water and dried in saw dust.—Journal der Goldschmiede-Kunst.

Anti-Damp Coating.—For the production of a white coating, dissolve 13 parts of caoutchouc, previously soaked in 5 to 10 decagrammes of ether, in 1 kilogramme of warm linseed oil, and add 4 more decagrammes with stirring. Now add 5 decagrammes of rapeseed oil, and 5 decagrammes of litharge. Finally still add 15 decagrammes of Cologne glue, dissolved in hot water, and let the whole boil about 2 hours. At length add 19 decagrammes of colophony and 2½ kilogrammes of zinc white.

If the paint is to be colored, the zinc white is replaced by a corresponding earth color.—Neueste Erfindungen und Erfahrungen.

Tooth Powders.—Odontologie publishes the following recipes:

No. 1.—Soap 1; saccharin 0·025; thymol 0·05; lime carbonate 50; sassafras essence 1 to 2 drops.

No. 2.—Camphor 0·5; soap 1; saccharin 0·025; calcium carbonate 50; oil of sassafras, of cassia or of gaultheria 1 to 2 drops.

No. 3.—Tooth powder à la violette:—Naphthol B 0·05; saccharin 0·025; lime carbonate 1; soap 50; jonon and cananga essence (mixed in the proportion of 15:1) 1 to 2 drops.

No. 4.—Astringent tooth powder:—Myrrh 1; sodium chloride 1; soap 50; lime carbonate 50; rose oil as required.

No. 5.—Menthol tooth powder:—Mentho l 0·10; naphthol B 0·95; saccharin 0·025; lime carbonate 50; rose oil as required.

No. 6.—Cement for carious teeth:—Make zinc oxide into a stiff paste with a sufficient quantity of eugenol.

Preservation of Eggs.—Karl Reinhard of Kaiserslautern recommends a treatment with sulphuric acid. The processes hitherto proposed for preserving eggs are mostly confined to a mechanical surrounding of the eggs with a substance intended to stop up the pores of the shell. Water-glass, lime-milk, etc., have been proposed for this purpose, which do not enter into a chemical combination with the substance of the egg shell. The methods consisting in mechanical covering of the eggs present the drawback that the eggs treated in this manner acquire an insipid, lixivious taste and odor and that a preservation in the true sense of the term does not take place, because the access of air through the pores of the coating and of the egg shell is not fully prevented by the enveloping substance. In contradistinction to this known process, the Reinhard method is said to cause such chemical changes in the surface of the egg shell, that it is closed up perfectly air-tight and an admittance of air is entirely excluded, even in case of long continued storing. For this purpose the eggs are for a short time exposed to the direct action of sulphuric acid, whereby the surface of the egg shell, which consists chiefly of lime carbonate, is transformed into lime sulphate. The dense texture of the surface thus produced forms a complete protection against the access of the outside air, which admits of storing the egg for a very long time, without the contents of the egg suffering any disadvantageous changes regarding taste and odor. The egg does not require any special treatment to prevent cracking on boiling, etc.

We would call attention to the fact that some time ago oxalic acid was recommended for this purpose, which is evidently entirely analogous in its action to sulphuric acid. What speaks in favor of the latter is its destructive action in the beginning upon the bacteria of putrefaction contained in the shell.—Materialist.

Refining of Potato Starch.—The object in refining potato starch is to produce tasteless and odorless dextrine or soluble starch. The penetrating odor and taste of dextrin produced by former methods is due to the fusel-oil contained in the potato starch. In order to remove this fusel-oil the starch is refined with chloride of lime, whereby the starch is bleached at the same time. This is accomplished as follows:

A suitable quantity of chloride of lime, fluctuating according to its quality between ½ to 1 kilo. per 100 kilos. of starch, is made with little water into a thick paste. To this paste add gradually with constant stirring 10 to 15 times the quantity of water and filter.

The filtrate is now added to the starch stirred up with water; ½ kilo. of ordinary hydrochloric acid of 20° Bé. previously diluted with four times the quantity of water is mixed in, for every kilo. of chloride of lime, the whole is stirred thoroughly and the starch allowed to rest.

When the starch has settled, the supernatant water is let off and the starch is washed with fresh water until all odor of chlorine has entirely disappeared. The starch now obtained is the resulting final product.

If the starch thus treated is to be worked up into dextrin, it is treated in the usual manner with hydrochloric acid or nitric acid and will then furnish a dextrine perfectly free from taste and smell.

In case the starch is to be turned into "soluble" starch proceed as usual, in a similar manner as in the production of dextrin, with the single difference that the starch treated with hydrochloric or nitric acid remains exposed to a temperature of 100° C., only until a test with tincture of iodine gives a bluish-violet reaction. The soluble starch thus produced, which is clearly soluble in boiling water without any pastiness, takes the place of the "Gommeline blanche" produced in the well known manner, but has the advantage over the latter of being perfectly odorless and tasteless.—Seifensieder Zeitung.

SELECTED FORMULÆ.

Grease Paints, etc.—

White.—Oxide of zinc, subnitrate of bismuth and plumbate of alumina, of each, 1 ounce; mix and make into a paste with almond oil (5 or 6 drachms required) and perfume with 12 minims of oil of peppermint, 12 grains of camphor, and 1 drachm of bouquet essence.

Deep Bordeaux Red.—Oxide of zinc, subnitrate of bismuth, plumbate of alumina, of each 15 drachms; oil of peppermint, 12 minims; camphor, 12 grains; carmine, 30 grains (dissolved in 80 minims of water in ammonia): almond oil, a sufficiency. Perfume with 1½ drachms bouquet essence.

Skin Color.—Vermilion, 3 drachms; tincture of saffron, 2 drachms; powdered orris, 5 drachms; precipitated chalk and oxide of zinc, of each, 20 drachms; camphor, 20 grains; oil of peppermint, 20 minims; almond oil, a sufficiency. Perfume with bouquet essence, as in the foregoing.

Theatrical face paints are sold in sticks, and there are many varieties of color. Yellows are obtained with ocher, browns with burnt umber, and blue is made with ultramarine. These colors should in each case be levigated finely along with their own weight of equal parts of precipitated chalk and oxide of zinc and diluted with the same to the tint required, then made into sticks with mutton suet (or vaseline or paraffine, equal parts) well perfumed. By blending these colors, other tints may thus be obtained.

Fatty face powders have a small percentage of fat mixed with them in order to make the powder adhere to the skin. The following formula is taken from Pharmaceutical Formulas:

Dissolve 1 drachm anhydrous lanoline in 2 drachms of ether in a mortar. Add 3 drachms of light magnesia. Mix well, dry, and then add the following: French chalk 2 ounces; powdered starch, 1½ ounces; boric acid 1 drachm; perfume, a sufficient quantity. A good perfume is coumarin, 2 grains, and otto of rose, 2 minims.

Nose Putty.—Mix 1 ounce wheat flour with 2 drachms of powdered tragacanth and tint with carmine. Take as much of the powder as necessary, knead into a stiff paste with a little water and apply to the nose, having previously painted it with spirit gum.

Nigger Black.—Beat the finest lamp black into a stiff paste with glycerin and apply with a sponge; if necessary, add a little water to the mixture when using. Or you can make a "grease paint" as follows: Drop black 2 drachms; almond oil, 2 drachms; cocoanut oil, 6 drachms; oil of lemon, 5 minims; oil of neroli, 1 minim; mix.—Formulas from the Pharmaceutical Era.

Black Shoe Dressing.—The following formulas are said to yield satisfactory shoe dressings for black leather:

1. Castile soap, white	1	ounce av.
Sandarac	1	" "
Mastic	½	" "
Venice turpentine	2	" "
Shellac	3¾	" "
Aniline black E	1½	" "
Glycerin	2	fl. ounces.
Water	3	" "
Alcohol	24	" "

Dissolve the soap in the water mixed with 7 fluid ounces alcohol; macerate in a warm place with frequent agitation, subsequently filtering through cotton. The mastic, sandarac, and Venice turpentine should be dissolved in 9 fluid ounces alcohol and the solution also filtered through cotton. Then dissolve the shellac and aniline in the remainder of the alcohol. Now mix the three solutions and add glycerin. The mixture should be dispensed in wide-mouth bottles, the corks being supplied with a wire which has a sponge attached to it.

2. Caoutchouc	1	ounce av.
Petroleum	1	" "
Carbon disulphide	1	fl. ounce.
Shellac	4	ounces av.
Lampblack	2	" "
Oil of lavender	1	fl. drachm.
Alcohol	20	fl. ounces.

Upon the caoutchouc, contained in a bottle, pour the carbon disulphide; cork well and let it stand a few days, or until the caoutchouc has become thoroughly gelatinized or partly dissolved; then add the petroleum, lavender oil, and alcohol, next the shellac in fine powder, and heat to about 50° C., taking care that as little as possible is lost by evaporation. When the substances are all dissolved and the liquid is tolerably clear, add the lampblack, and fill at once into small bottles.

3. Shellac	2	ounces av.
Gum turpentine	¾	" "
Sandarac	144	grains.
Lampblack	72	"
Oil of turpentine	6	fl. drachms.
Alcohol	19	fl. ounces.

—Bulletin of Pharmacy.

Sunburn Remedies.—

1. Zinc sulphocarbolate	1	part.
Glycerin	20	"
Rose water	70	"
Alcohol (90 per cent.)	8	"
Cologne water	1	"
Spirit of camphor	1	"
2. Borax	4	parts.
Potassium chlorate	2	"
Glycerin	10	"
Alcohol	4	"
Rose water to make	90	"
3. Citric acid	2	drachms.
Ferrous sulphate (cryst)	18	grains.
Camphor	2	grains.
Elderflower water	3	fl. ounces.
4. Potassium carbonate	3	parts.
Sodium chloride	2	"
Orange flower water	15	"
Rose water	65	"
5. Boroglycerin (50 per cent.)	1	part.
Ointment of rose water	9	"
6. Sodium bicarbonate	1	part.
Ointment of rose water	7	"

—Bulletin of Pharmacy.

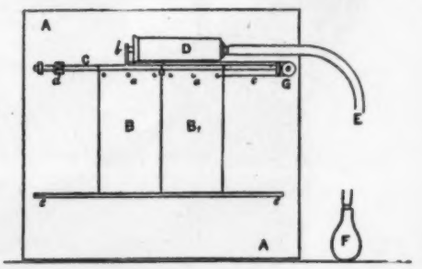
A PNEUMATIC SHUTTER FOR OPTICAL EXPOSURES.

IN the course of work concerning the more complicated mental processes the need is often felt for a simple optical shutter, which will be at the same economical and thoroughly workable. Of the various forms of such shutters hitherto devised the pneumatic is undoubtedly the best; but the majority of its varieties are so complicated and expensive as to make it highly desirable to obtain a simple form of apparatus, especially when the progress of simultaneous investigations makes the duplication of the shutter necessary.

The mechanism, of which a cut is given below, has been devised for use in the Harvard laboratory in connection with an investigation in which it was necessary to expose at the same time an object of moderate size and its name in printed letters. The apparatus is inexpensive, and can be made in any laboratory or workshop in the course of two or three hours.

The body of the shutter consists of an upright rectangular sheet of thin wood, *AA*, 16 inches long by 14 wide, and faced with black cardboard. In the center of this screen is a square aperture, 6 inches in diameter, and having its sides parallel with those of the screen itself. To the back of this sheet of wood is attached the mechanism of the shutter. This consists, in the first place, of two rectangular screens of black cardboard, *BB*, each 3½ inches by 6½ high, which are carried by sections of brass tubing, of ½ inch inside diameter, to a projecting flange of which they are rigidly attached by screws, *aa*. These pieces of tubing are mounted on a horizontal brass rod, *C*, ½ inch in diameter, on which they move freely. Above this carrying rod and parallel with it is clamped an ordinary medical syringe, *D*, having a plunger with a plain pencil end. To the nozzle of the syringe is attached a flexible rubber tube, *E*, connected with a large sized pressure bulb, *F*.

This syringe furnishes the motive power of the shutter, applied in the following way: To the carrier of the one-shutter leaf, *B*, is soldered a strip of stiff brass, *b*, which projects in front of the plunger of the syringe. As the plunger is driven forward by the pressure of air in the syringe, therefore, it carries this half of the shutter with it. At the same time the action of a silk thread, *c*, attached to the brass strip, *b*, at one end, and to the second half of the shutter, B_1, at the other, and passing over the pulley, *G*, draws the leaf, B_1 in the opposite direction. The aperture thus produced is 6 inches in height and in width is twice the distance traveled by the plunger of the syringe. The automatic closing of the shutter upon the release of the pressure bulb is obtained by connecting the two



leaves of the shutter by an elastic rubber band passing around the screw heads, *aa*. The movement is centralized by a block (appearing in the cut at the top of the line marking the meeting of the two halves of the shutter) which at the proper point arrests the further motion of the shutter leaves. The rapidity of the closing movement may be controlled by changing the strength of the elastic band. The width of the aperture is controlled by means of a sliding top, *d*, on the brass carrier rod, which is fixed in position by a set screw. The bottoms of the shutter leaves are carried in guides, *ee*.

The mechanism has been found to work very satisfactorily. The movement is easy and rapid, the time—and of course the extent—of the exposure are nicely controllable, and the apparatus is applicable to all work except such as may require a centrifugal action of the leaves. It is especially convenient for work on perception, visual memory, association and all cases where numbers, words, sentences and the like are to be exhibited. For such use the screen is rotated so that the edge which in the cut forms the right hand side of the apparatus becomes its base, and the movement of the shutter leaves is vertical instead of horizontal. The aperture then becomes a horizontal slit, 6 inches in length, and of a width varying according to the needs of the experiment, and controlled by the position of the stop, *d*. For second series exposures, when an upper row only of letters or figures is to be exposed after a double row has been exhibited, the silk thread may be slipped off the pulley, when the leaf, *B*, alone will be moved by the action of the plunger, the return being brought about as in the previous case by the elastic connecting band.

A still simpler form of exposure, which may be found adequate for some kinds of work, involves practically the cost of the syringe itself. A tight fitting cap of brass tubing is made for the end of the plunger. The projecting half of the tubing is sawed down at opposite sides and pinched flat, forming a spring clamp, within the jaws of which cards bearing numbers, letters and the like may be slipped and held firmly. To use the mechanism it is necessary only to clamp the syringe vertically behind a screen and in such a position in relation to it that the top of the card to be exposed comes, when ready for exhibition, in a line with the bottom of the aperture in the screen. Exposure is made as before by pressure upon the bulb, the card itself rising into view and disappearing instead of being exposed by a moving shutter as in the previous case. The return of the shutter downward is brought about by the air pressure in the syringe, or, if the piston works stiffly, by an elastic rubber band passing through the end of the plunger and bound to the barrel of the syringe.

In closing, I wish to point out the applicability of the syringe to experiments on the dermal senses. For this purpose the syringe barrel is clamped rigidly in a vertical position, the instrument with which contact is to be made is attached by thumbscrew or other device to the end of the plunger, and application is made by simple compression of the air bulb. Such a method has several distinct advantages over exploration with an instrument held in the hand. One of these is the possibility of giving the successive stimulations with local exactness, a condition scarcely to be looked for by the hand method even when the positions are permanently indicated by marks on the skin. The tremor of the hand is got rid of, and the application is clean, firm and even. It will probably be found also that the time of stimulation is more controllable.

The only instance of the employment of an analogous method of which I am aware is that reported by Krohn (Jour. Nerv. and Ment. Diseases, March, 1893) in experiments on simultaneous touch stimulations, in which he used Marey's tambours, to the faces of which were attached the instruments of contact.—Robert MacDougall, Harvard University, in Psychological Review.

SOME DETAILS OF ARMY PRACTICE IN GERMANY.

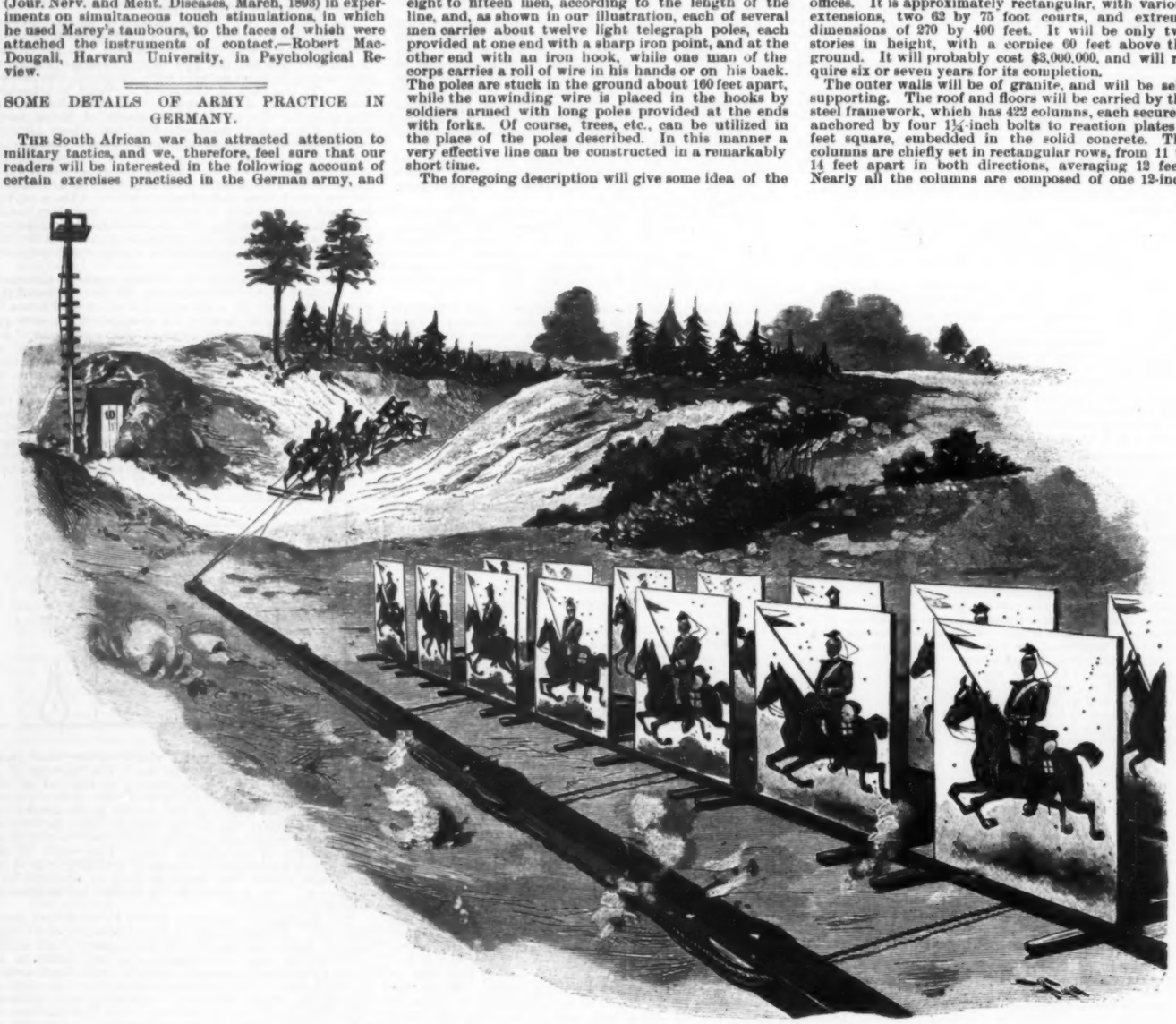
THE South African war has attracted attention to military tactics, and we, therefore, feel sure that our readers will be interested in the following account of certain exercises practised in the German army, and illustrated in the accompanying engravings, for which we are indebted to our contemporaries, Die Illustrirte Zeitung and Das Buch für Alle.

In the German army special care has always been given to target practice, and real service begins only after due preparation in aiming and shooting—guns provided with sights and blank cartridges being used—and in exercises designed for teaching true distance values. The latter is, of course, most instructive when carried on in open country, where the distances from objects aimed at are unknown, and can be ascertained only by actual firing. In such work, only loaded cartridges are used. But even this did not fill all requirements, as the distance from stationary targets was easily learned after a few trials, a defect which was specially noticeable in cavalry practice, for in a real engagement the cavalry advances on its opponent very rapidly, and the positions of the objects aimed at are changed each second. In order to overcome this difficulty, movable targets have been arranged on skids drawn forward by means of ropes attached to horses driven at full speed. The ropes run over rollers secured to a heavy beam. The arrangement of these targets is clearly shown in one of our illustrations. The infantry is marched out and drawn up in columns, those in front kneeling during the shooting. The men aim at the horses' legs, but balls which miss the aim and strike the ground are deflected so as also to be dangerous to the horses. After the practice is over the targets are inspected and the good hits counted, even those shots which did not strike the horse or the rider but did hit the target being included, and the company which has the best count receives due praise as well as prizes.

Another branch of service which is now receiving attention in Germany is the running of telegraph lines by cavalry. Heretofore, in time of peace, there were only two schools in Germany for the instruction of military telegraphers, one in Berlin and one in Munich, but during the past year two divisions of troops have been set apart specially for this service, and certain changes are to be made in the schools.

The duty of the telegraph battalion in time of war is, of course, to run lines between the operating corps and headquarters, or between the advance posts and the divisions, which are from half a mile to five miles behind them, so that all the observations made by the former can be transmitted with the rapidity of lightning to the latter. A division of cavalry intrusted with the construction of a telegraph line consists of about eight to fifteen men, according to the length of the line, and, as shown in our illustration, each of several men carries about twelve light telegraph poles, each provided at one end with a sharp iron point, and at the other end with an iron hook, while one man of the corps carries a roll of wire in his hands or on his back. The poles are stuck in the ground about 160 feet apart, while the unwinding wire is placed in the hooks by soldiers armed with long poles provided at the ends with forks. Of course, trees, etc., can be utilized in the place of the poles described. In this manner a very effective line can be constructed in a remarkably short time.

The foregoing description will give some idea of the great care given to all details in the thorough drilling of German soldiers.



MOVABLE TARGETS USED IN THE GERMAN ARMY.

A JAPANESE IMPERIAL PALACE.

AMERICAN engineers and manufacturers have been engaged to design, construct and erect the steel framework of a large palace for the Crown Prince of Japan. Besides the interest attached to such an important foreign contract, this structure, says The Engineering Record, has special details designed to meet conditions unknown in the United States, for Japan is subject to an average of 300 earthquakes every year. These quickly overthrow ordinary brick buildings. Wooden frames endure the vibrations better, but are very undesirable on account of their inflammability. At present the architecture is in a transition stage, but there is a tendency to build the houses with steel frames.

This palace will be much the tallest building in Japan, and its safe construction was pronounced impossible by prominent architects in Japan and Europe. The fundamental principle and leading consideration in the design have been not only to provide for its stability under a single severe earthquake shock, but to insure its endurance of numerous shocks continuing year after year at frequent intervals. To meet these strains and vibrations every part of the building is supported or reinforced by a skeleton steel framework made continuous throughout, so as to act as a whole to resist displacement of any part. There are very few adjustable members or loose joints. Nearly all connections are riveted with unusual strength, although they are not so rigid but that the members may deflect within the limits of their elasticity without injury. Special lateral strength and stiffness are introduced by systems of struts and ties in all the horizontal planes, which develop the strength of the beams and girders, and practically create great horizontal trusses to resist distortion and distribute strains. The masonry is massive, proportioned for stability, and abundantly anchored at all points to the steel framework. The solid continuous floors add to the strength and rigidity of the structure, and its stability is promoted by making the cornice, parapet and other upper parts as light as possible. The whole building is seated on wide continuous footings of solid concrete, to which the columns are each bolted.

The palace is designed as a residence for the Crown Prince's household, and to contain some of the State offices. It is approximately rectangular, with various extensions, two 62 by 75 foot courts, and extreme dimensions of 270 by 400 feet. It will be only two stories in height, with a cornice 60 feet above the ground. It will probably cost $3,000,000, and will require six or seven years for its completion.

The outer walls will be of granite, and will be self-supporting. The roof and floors will be carried by the steel framework, which has 422 columns, each securely anchored by four 1¼-inch bolts to reaction plates 2 feet square, embedded in the solid concrete. The columns are chiefly set in rectangular rows, from 11 to 14 feet apart in both directions, averaging 12 feet. Nearly all the columns are composed of one 12-inch 31½-pound I-beam and two 12-inch 20½-pound channels with their flanges connected by 6 by ⅜-inch tie-plates 4 feet apart. Each column is in three lengths of from 16 to 23 feet, and is spliced with four cover-plates 12 inches above each floor line. A system of horizontal bracing was designed to connect the shoes of all columns. Transverse and longitudinal struts were put in every row, and the panels formed by their intersections were in most cases provided with crossed diagonals. The struts were of rectangular cross section, made of four 4¼ by 3-inch angles latticed on all sides, and are 12 inches wide and 16 inches deep, with riveted connections. The diagonals were single 5 by 3½-inch or 6 by 3½-inch angles.

In the first floor the girders are all pairs of I-beams or channels, usually the former, from 10 to 15 inches deep, and the 7 and 8-inch floor beams, about 4 feet apart, are web-connected to them with their lower flanges flush with those of the girders. The girders are connected to the columns by horizontal shelf angles across their top and bottom flanges, and also have web-connection angles to the column flanges. Besides this, the girder flanges are cut to clear the webs of the column channels, the ends of the I-beams extend 3 inches inside the columns, and the beam and channel webs are riveted together back to back. This arrangement is designed to develop satisfactory bearings, great rigidity and a large proportion of the tensile strength of the beams, which thus act as ties throughout the building.

The floor beams are connected by ⅝-inch tie-rods through the webs 4 inches above the bottom flanges,

with the usual nut bearings. Sheets of No. 16 corrugated iron are sprung between the lower flanges of the floor beams to make continuous segmental arch soffits of 12 inches rise. Above the corrugated iron concrete is filled in solid to depth of 6½ inches above the crown, or 8½ inches above the deepest girders, and the wood floor is laid on this. Under the lower flanges of the beams and girders is a false ceiling of wire cloth and plaster. The second floor is identical in general construction with the first. Neither has any diagonal bracing, but in or adjacent to the planes of all the walls, both interior and exterior, there is at both floor levels a horizontal strut composed generally of two 10-inch channels well riveted to the columns at right angles to the floor girders. These struts are web-connected to vertical gusset plates. In a few instances a similar connection is adopted for pairs of channels used for floor girders, where they connect to interior columns.

The ceiling of the second story is in the horizontal plane of the lower chords of the roof trusses, and is divided into rectangular panels corresponding with the intersections of the rows of columns, by the roof trusses and by column struts at right angles to them. The struts are pairs of 8-inch channels with their flanges turned inward, and are connected like those in the planes of the floor. The panels are subdivided by transverse ceiling beams, usually 6-inch 14¾-pound I-beams, about 6 feet apart, which are web-connected to the lower chords of the roof trusses. In each main panel there is a pair of intersecting diagonal rods 1 inch in diameter with 1⅛-inch upsets, which have clevis connections to separate 1½-inch vertical pins through the knee brace with bent plate connections is run from near the end of the truss to the strut over each column, and a short column and bracket are riveted to the end of the truss to carry the parapet and cornice frame work. All window and door openings are spanned by plate girders or beams to which the granite arch voussoirs are anchored. For the wider openings there are plate girders 30 inches deep which are web-connected to the column channels and have solid web knee-brace brackets under their ends.

The tangent of the slope angle of all the main roofs is 0·7, and of the pediment roofs 0·4. Most of the roof trusses are A-shaped, of from 30 to 50 foot span, and are rigidly connected to columns at the ends and at one or more intermediate panel points. The top chords form the rafters, and the bottom chords carry the ceiling beams. All the truss members are pairs of angles riveted together back to back, except the bottom chords, which are pairs of 8-inch channels riveted together back to back. All connections are riveted to vertical gusset-plates between the pieces of the different members. The trusses have a simple triangular web system with vertical and inclined members. There is a zigzag diagonal bracing of 3 by 3-inch angles riveted to the tops of the rafters in the end panels between trusses and in every second or third intermediate panel. The chimneys are of masonry up to the second story ceiling; above that each has a framework with four vertical 4 by 4-inch angles riveted to the roof trusses, and connected together with horizontal struts and X-bracing of small angles on all sides. These are covered with copper and contain sheet metal flues.

The purlins are 6-inch 14¾-pound steel beams, from

CONSTRUCTION OF A TELEGRAPH LINE BY CAVALRY.

ends of tie-plates on the top flanges of the struts. The lower chords of the roof trusses are seated on horizontal angle shelves riveted across the faces of the columns and are continued beyond them and web-connected to the I-beams in the centers of the columns. Besides this the vertical connection plates, which are riveted to the flanges of each column, are extended beyond the channel webs and riveted to another pair of short vertical angles on the lower chord of the truss, so that great stiffness is secured in the connection and a large number of rivets would have to be sheared to permit displacement or serious distortion.

The columns are continued 3 feet or more above the roof truss connections and have cantilevers, brackets, and gusset plates for the connections of the horizontal angles, channels, etc., which form the skeleton of the copper cornice and the parapet. In the pediment of the main front, and adjacent to it, in the second story, there are ornamental granite columns made in short vertical sections, cored out and slipped over center columns of welded steel tubes. Some of these columns are in pairs, about 3 feet apart, and are 8 inches in diameter and ¾ inch thick. They have bottom flanges made of 5 by 3 by ⅜-inch angles bent to complete circles and seated on special wall beams just above the regular column struts. The tops of these columns have segmental flanges made of pairs of bent 6 by 3½-inch angles through-bolted to them. An 8 by ¾-inch horizontal cap plate 4½ feet long is bolted to the flanges, forming a brace to connect the columns and affording a seat in the middle for the end of the roof truss. The regular column struts are bolted on top of the cap plate and their ends abut on the web of the lower chord of the roof truss. A horizontal

5 to 8 feet apart, which are bolted to the top chords of the roof trusses and braced at every support by a knee-brace plate like an oblique Z bent over the top flange of the beam. Wooden 2 by 4-inch nailing strips are bolted to the top flanges of the purlins, and on them are set 2 by 8-inch jack rafters, 2 feet apart, which are dapped 2 inches at the seats. A solid course of transverse sheathing boards, ⅞ inch thick, is nailed to the jack rafters, and on it is laid a double thickness of tar paper and the roofing slate. Nearly all field connections are riveted, and have an excess of 25 per cent. over the number of rivets in shop driven work. The length of all columns and other members was limited to 34 feet for shipment.

Mr. Tokuma Katayama, architect to the Imperial household and architect of the palace of the Mikado, is the architect for this palace. He has recently visited the United States and engaged Messrs. E. C. & R. M. Shankland, Chicago, to design the steel work, for which a $200,000 contract has been awarded the Carnegie Steel Company. Mr. C. M. Wilkes, Chicago, has been retained to prepare plans and specifications for the heating and ventilation, and Mr. R. D. Gottlieb, assistant engineer of the Carnegie Company, will supervise the erection of the steel work.

Mineral Production of Western Australia.—The Mines Department of Western Australia reports the mineral production of the Colony, outside of gold, in 1899, at 566 tons tin; 12,852 tons iron ore, used as flux in the smelting works; 17,593 tons of limestone, also used as flux. The coal production, all from the Collie coal field, was 57,844 tons.—Engineering and Mining Journal.

ENERGY OF BECQUEREL RAYS.

IN a further note on the question as to the origin of the energy possessed by the Becquerel rays (see ante, p. 333), it is pointed out that the existence of substances capable of emitting radiations possessing energy, without any appreciable loss of weight or introduction of work from external sources, would appear to be impossible from the view of conservation of energy. The measurements of M. Henri Becquerel upon the deviation of the radium rays in an electric field, taken in conjunction with those of M. and Mme. Curie of the charges carried by those rays, lead to results which show a way out of this difficulty, on account of the extreme minuteness of the quantities of energy in question. The calculations of M. Becquerel show that the energy radiated per square centimeter is of the order of one ten-millionth of a watt per second. Hence a loss of weight of about a milligramme in a thousand million years would suffice to account for the observed effects, assuming the energy of the radium to be derived from an actual loss of material.—Nature, 61, 547.

MEDICATED WATERS.

A. G. CRIDDLE and W. O. Richtmann compare the results of preparing medicated waters by various methods, and state that all the evidence is in favor of the method depending upon impregnation of and filtration through cotton. The waters are easier and more readily prepared, retain their strength and quality of odor longer, do not become turbid, remain free from fungus growths, contain practically no foreign matter, and are not incompatible with the substances with which they are most frequently combined. Waters prepared by the aid of cotton gave no reaction with silver nitrate, ferrous sulphate, copper sulphate, or zinc sulphate. The same result was noted in the case of medicated waters prepared by agitation with cold water, or by distillation of water vapor through cotton impregnated with volatile oil. When kieselguhr or talc was used as a filtering agent the resulting waters gave no precipitate, but those prepared by filtration through calcium phosphate or magnesium carbonate gave precipitates with several of the reagents. Cocaine hydrochloride, atropine sulphate and boric acid were not affected by medicated waters prepared by any of the methods tested.—Pharm. Archives, 3, 22.

ARTIFICIAL COLORS IN MILK.

A. E. LEACH presents a scheme for the detection of foreign coloring matter in milk, more especially annatto, caramel, or aniline orange. About 150 c. c. of the milk is curdled by the aid of heat and acetic acid, the curd macerated with ether, and the ethereal extract separated. The ether is then removed by evaporation, the residue made alkaline with sodium hydroxide and poured on a wetted filter which will be colored orange if annatto be present. If the extracted curd be orange or brownish in color, it is shaken up with concentrated hydrochloric acid; the solution immediately becomes pink if aniline orange be present, or gradually turns blue if caramel has been used as a coloring agent.—Journ. Am. Chem. Soc., 22, 207.

EXCAVATIONS IN THE ROMAN FORUM.

AN interesting illustrated article on the new finds in the Roman Forum was published in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1269, and we now present another article dealing with a different phase of the subject.

Last year nothing was visible of the Regia but a few blocks of marble attributed to the reconstruction of 36 B. C., the surrounding earth not having been removed below the level of the pavement of the court in front of the temple of Vesta, and of the altar on the steps of the temple of Antoninus and Faustina. A vast and depressing layer of mediæval paving stones, broken and furrowed in various fashions, represented the so-called Via Sacra, arbitrarily located between the temple of Vesta and the Regia, and recently saddled with a new drain brought thither across republican masonry at the angle of the Regia, cutting up a well of the second and third century B. C. full of votive offerings, and damaging a fine Etruscan structure—the front of the Temenos or sacred inclosure of the Vestals—once plastered with delicate opus albarium. The well referred to above is twenty feet deep, and contained ashes, cinders, Etrusco-Campanian pottery with a black surface, architectural fragments and weights in terra-cotta, and an antefix representing Venus.

The presence of the votive offerings points to the well being considered sacred; while their date, as well as that of the structural formation of the tufa lining, would coincide with that of the Puteal Libonis, a "fulguritum" of 195 B. C.

That the so-called Puteal Libonis must in future be looked upon as a purely mediæval structure, probably a cattle trough, has been placed beyond all doubt by the fact that it overlaps a portion of one of the pedestals of the Arch of Augustus, and that a drain constructed in Imperial times passes beneath it.

Explorations have frequently been carried out in the Regia for the purpose of ascertaining the boundary and divisional walls. Mr. Nichols, some fifteen years ago, recognized the official residence, not the Domus Publica, of the Pontifex Maximus. Dr. Hülsen succeeded in excavating and identifying several architectural fragments belonging to a late restoration, among which was a portion of the cornice of the obtuse angle formed by the eastern side, where was the entrance, and the southern side opposite the temple of Vesta.

It was no secret that the Collegium of the Pontifices and Flamines served the purpose of a Record Office for Annals of State; that the consular and triumphal Fasti of the Romans were incised on its walls, and that within its precincts existed the sacraria of the Hastæ Martiæ and of the goddess Ops Consiva; yet no trace of them had ever been found, or even sought for. The complete destruction of the building was attributed to the sixteenth century, and this sufficed.

Nothing is so injurious to archæological research as that indolence of the brain which causes people, not only to accept for themselves as irrefutable canons, but to induce others, who have neither the means nor capacity to inquire for themselves, to place faith in opinions expressed in the first instance as provisional conjectures, and intended to be considered as such until justified by positive research. The preconception that the destruction of the Regia was accomplished in the sixteenth century, and the direction assigned to the Via Sacra—in opposition to the statements of Varro—have retarded the solution of the problem and caused irreparable damage to the Regia itself.

Pirro Ligorio,* when referring to the discovery in 1546 of the marbles on which the Fasti were incised, states that as the excavations (conducted in search of building material for the construction of St. Peter's) approached the ground, part of the inscriptions were found in situ, and that, notwithstanding this, they continued removing them down to the foundation.

No account has been taken by modern archæologists of the assertion of Ligorio that "the same destructive process had already been carried on in former times" (attributing perhaps to vandalism that for which the vandals were in no way responsible), nor of the statement of Panvinio in the Preface to the Fasti published in Venice in 1558, that a portion of the blocks composing the Regia had already been employed as steps in the churches, dispersed among private houses or reduced to lime previous to the excavations of 1546; and that the lime kiln was not only discovered hard by, but that blocks of marble which had escaped the fire had already been sawn into slabs "on which had been carved birds, flowers, Solomon's knots, and other barbarous ornamentations—utterly senseless—similar to those on the panels of pulpits and choirs in Roman Basilicas."

From his point of view, Panvinio could not have given a better description of the ecclesiastical sculptures of the eighth and ninth century, produced in a mediæval marble yard adjoining a lime kiln at the entrance of the Roman Forum.

The fact that search was made far and wide by means of tunneling for fragments broken off the Regia is in itself a proof that their dispersion had already been effected, not only previous to the excavations of the Renaissance, but before the Forum became filled with earth. With reference to the above, I may here mention that among the pieces of marble considered to have formed the architectural decoration of the walls on which the Fasti were incised and enriched with exquisite chiseling of the Flavian age, I recognized a piece of a cornice which had been readapted during the Carolingian age for architectural purposes, and retained on one side the characteristic garlic moulding of the second half of the first century, and on the other a barbaric cross of the eighth with a central boss, and branches the ends of which are divided and bent round on either side in the form of a spiral.

The facetiousness, not unmixed with sarcasm, with which Flaminius Vacca excuses the occurrence, frequent enough in his day, of an ancient statue being dispatched to the lime kiln, "to take the damp off his back after his many years under ground," does not exclude the presumption that the furnace and the saw had a prejudicial effect on Roman monuments many centuries before the sixteenth.

The Regia discloses a trapezoid of which the smallest side—that facing east—contains the ruins of the stairs of approach. The southern side, composed of three regular courses of tufa surmounted by a layer of pozzolana concrete, faces the "Temenos of Vesta." The wall of the western side, constructed of square blocks of travertine, rises from the lower level, likewise trapezoidal, of the adjacent office of the Kaletores Pontificum et Flaminium paved with delicate black and white striped mosaic. This hall terminates in a wall of opus reticulatum, where was originally an entrance door, passing which the boundary wall of the Regia is formed of square blocks of tufa similar to those of the Etruscan "Temenos."

At a distance of 6 feet from this side of the Regia, the foundations of the back of the Heroon of Julius Cæsar have been brought to light, of which the Cella appears to have more symmetrical proportions than have been hitherto attributed to it.

The northern side of the Regia, facing the Via Sacra, was brought to view by the reduction of the latter to the level of Imperial times, a process which laid bare the lower steps of the approach to the temple of Antoninus and Faustina, restoring ito that building the majesty of its original proportions. It also disclosed the steps of the Regia, which at this point formed the curbstone of the Via Sacra, and by which access was obtained to a late Portico supported by columns of cipollino resting on bases of red granite. The travertine foundations of the northern side were found behind the steps at a depth of 8 feet, and at an average distance of 6 feet from these steps is the tufa wall of the earliest façade.

In the intervening space, close to the northwest angle, a republican well was discovered and emptied, 2 feet 4 inches in diameter, lined round with slabs of tufa in five segments, each averaging about 2 feet 2 inches in height, and containing thirty-five recesses for the feet descending in two alternating rows to a depth of 46 feet below the marble pavement. It was covered over at haphazard with blocks of tufa, including a republican tile, bearing traces of a Greca pattern painted in perspective in blue, yellow, green, gray, red, and black, with a border of white.

The well was empty to the depth of several yards, and the walls were blackened by fire. Below were discovered pieces of tufa bearing traces of the conflagration, rubble earth, and portions of the remains of a circular wooden covering, constructed of small pieces

dovetailed together, and now practically reduced to a black mass. Six weights of terra-cotta lay at the bottom of the well, also fragments of cups and Etrusco-Campanian vases of a black surface stamped with rosettes. The walls of the well rest on clay, while the bottom is filled with a layer of gravel 12 inches thick.

The explorations within the precincts of the Regia, well advanced though not completed, present exceptional difficulties and demand the greatest attention, relating as they do to a monument which may be looked upon as an architectural palimpsest of fifteen centuries of stratifications—a monument which served to register and hand down to posterity the records of the most salient facts of Royal, Republican, and Imperial Rome.

In one well alone, and that not an old one, which was dug out so as to reach geological stratification, no less than 8 feet of super-elevation due to Imperial times, including a tufa wall of the time of the Republic, and subsequently 27 feet 10 inches of rubble earth were traversed before the alluvial deposit was reached.

The Regia faced east, and remains of the entrance exist in the jambs, cut down to the level of the marble pavement. Outside this entrance must have been the vestibule of the Regia, of which the sides were formed by the prolongation of the main walls, here constructed of blocks of marble with roughly hewn surfaces. The removal of the earth at this point disclosed two steps descending from the threshold, their angles worn by the action of the feet; also a portion of the marble pavement of the vestibule laid on an earlier level of tufa.

The entrance gave access to a hall in communication with another which extended toward the west as far as the main boundary wall adjoining the office of the Kalatores. To the right of these halls were others confined by a wall somewhat in recess of that which supports the flight of steps of late date which led to the Via Sacra. The boundary and divisional walls of these halls are composed of Opus Quadratum in tufa similar to that of the side facing the Temenos of Vesta; they appear to date from the Republic and are surmounted by a projecting mass of concrete of red pozzolana, which probably indicates the level at which Domitius Calvinus commenced the reconstruction of the building during the life of Julius Cæsar.

The floor of the second hall facing the entrance is paved with blocks of yellow tufa 8 inches thick, and surrounds a truncated circular structure of gray tufa slightly conical, 8 feet 4 inches in diameter.

The paving stones are worn by friction around this circular structure, of which the segments below the level of the pavement rest upon a substratum of earth containing fragments of rough pottery, among which was discovered a spindle weight, a terra-cotta saucer, and a republican bronze coin (as), stamped with a double-headed Janus.

The hall to the side contains a republican well 2 feet in diameter, the walls of which rest upon gravel in which were discovered ten used "knucklebones," one ivory die, a bronze cup, and a portion of the skeleton of a weasel.

Against the western wall of the Regia a small square construction of blocks of tufa was unearthed, around the upper margin of which is a circular projection 3 feet in diameter; and hard by a fragment of peperino, cylindrical in form and incised with the following letters, "A C O V R I" filled in with red. Their shape coincides with that of the lettering on the tombs of the Scipios, now in the Vatican Museum, the earliest Latin monumental inscriptions known before the discovery of that on the Stele beneath the Niger Lapis (see below). The remains of the tufa blocks which formed the pavement of this hall were also exposed, together with some small tufa channels, no doubt used for sacrificial purposes.

But the most important discovery was that of a storepit in the form of a Tholos, 14 feet 7 inches deep and 10 feet maximum inside diameter, cylindrical in form to a height of 7 feet 3 inches and conical for the truncated portion above, where is to be seen the mouth of a rectangular tufa drain or gutter 5 inches wide and 3 inches deep. The walls of this storepit are constructed of gray tufa blocks 8 inches in thickness, neatly worked and placed horizontally in regular courses of from 14 to 17 inches in height. The side of these blocks facing the interior is concave and plastered, whereas that facing the exterior is more roughly finished and surrounded by a layer, 20 inches deep, of the reddish clay extracted from the interstices of the quarries of basaltic lava on the Via Appia, still used for paving Roman roads. This clay is wedged into the joining of the tufa blocks, and is itself surrounded by a layer of tufa 6 inches in width.

The bottom of the Tholos is of well-laid earthenware concrete (opus signinum) having a slightly concave surface, around which is a raised rim from which spring the vertical walls.

The level of the truncated conical portion is 4 feet 8 inches below that of the marble pavement of the Regia, and corresponds to that on which the republican pavement of tufa was laid. This pavement, if prolonged, would cover the margin of the Tholos and support the steps on which was erected the parapet.

For about half its depth the Tholos was full of earth containing the bones of domestic animals and fragments of mediæval vases; lower down Imperial pottery was reached, among which an amphora 21 inches high; a vase 8 inches high, with one handle, bearing the following inscription painted in black:

P GABINI
SEL

another similar vase 10½ inches high, with the following inscription painted in red:

PHILIPPUS

the bottom of a red terra-cotta cup of Arezzo ware, with the following stamp:

C. SERI
OCEL

further, three lamps and three jars for ointment.

Besides the pottery vases, nine fragments were discovered of a round parapet of crystalline limestone, slightly conical in form, ten inches wide at the mouth, and having a moulded plinth and cornice, the latter inscribed with the word Regia.

Seventy-eight stili lay at the bottom of the Tholos, varying in shape and length, some short and stumpy, others graceful and thin, having the sharpest points, though a few are broken or repaired with a knife. All are products of the lathe. Together with the stili was found a somewhat blackened oaken table (tabella) 4 inches long, 11¾ broad, and about the twentieth part of an inch in thickness. It is accurately smoothed on both sides, showing signs of having been frequently scraped. On the surface are to be seen slight but undecipherable scratchings.

I imagined that the building thus brought to light was none other than the Atrium Vestæ (not to be confounded with the Atrium of the Vestals), to have skirted which was considered, 2,000 years ago, to be equivalent to having arrived "ad Vestæ."

I recognized in the circular structure a relic of the sacrarium of the Hastæ Martiæ—in the Tholos and the altar two relics of Ops Consiva. It was not without emotion and excitement that I turned my attention to the nature and object of these sacraria—for they seemed to me to contain the solution of the most important archæological problems that we have had to study in Rome since the discovery of the Niger Lapis (a pavement of black marble discovered last January in the Comitium; excavations beneath the stone have brought to light a very archaic inscription now occupying the attention of glottogists).

The spears kept in the Regia were venerated as the weapons of the mythical father of the first king and founder of Rome; hence, according to some, the derivation from curis (in Sabine "hastæ") of Quirinus, the name given to Mars and Romulus, and of Quirites to the Roman people.

The spears were wooden rods, hastæ puræ, with metal points. (Two bronze conical points were discovered in the present excavations of the Forum.)

They were in themselves objects of worship, if we can trust the authors to whom a historian of the time of Antoninus refers.

The Hastæ of the sacrarium in the Forum were probably two in number, dedicated to the Latin and Sabine Mars. This view is upheld by the fact of their being invariably alluded to in the plural, whereas the Hasta of Præneste is mentioned in the singular by the same author. On Roman coins the Hastæ are represented by two spears.

The form of a circle is in keeping with the sacrarium of a war god, and architectural tradition in this respect has been maintained in the case of the temple of Mars

* Cod. Taurin. 15, 194.

Ultor represented on a denarius and on a silver coin of the time of Augustus. The statement of Servius that it is to Vesta, Mercury and Diana that circular temples should be built does not preclude the erection of temples in that form to other divinities, still less that of small shrines. It must be borne in mind that the rectilinear Porticus near the Arch of the Pantani, dating from the time of Hadrian, must not be taken for the temple of Mars Ultor, a type of the architecture of the time of Augustus.

The sacrarium of Mars was an actual and genuine sacred seismic observatory, the record of the spears, as signaling a seismic disturbance, having been transmitted by a decree of the Senate in the year 99 B.C., which was read out by Aulus Gellius "in veteribus memoriis scriptum," when the Pontifex C. Julius L.F. announced that "in sacrario in Regia hastas Martias movisse," and ordained sacrifices of the most important victims ("hostiis majoribus"). Aulus himself states that they were shaken by earthquakes, "ut terram movisse nuntiari solet," etc.; it is further confirmed by the sacrifices decreed to Jupiter, Mars "et ceteris diis quibus videretur placandis," and by the closing sentence of the decree of the Senate: "Si quid succidaneis opus esset robus succederet," which subsequent sacrifices must be attributed to the fresh shock always expected and dreaded.

The inclusion of Jupiter among the gods to whom sacrifices were to be offered within the precincts of the Regia brings to one's mind the "rubente dextera" of Horace. Jupiter was represented as grasping his threefold bolt: the first penetrating, the second shaking, and the third burning; "quia id aut terebrat, aut discutit, aut urit;" also Festus and Seneca, "Trisulcum fulgur."

On such occasions the victims selected for sacrifice would themselves be of a peaceful nature, inasmuch as "maximam hostiam ovilli pecoris appellabant, non ab amplitudine cyrporis, sed ab animo placidiore."

The formulæ by which the oscillation of the spears were registered were almost always the same, if we may trust those that have come down to us either directly or from abstracts of the lost books of Livy:

Hastæ Martis motæ (A.U.C. 570).
Hastæ Martis in Regia motæ (A.U.C, 635).
Hastæ Martis in Regia sua sponte motæ (A.U.C. 650).
Hastæ Martis in Regia motæ (A.U.C. 654).
Hastæ Martis in Regia motæ (A.U.C. 657).

It is not known whether the spears were suspended so as to register the smallest oscillations, but it is certain that their vibration was considered as the forerunner of disaster.

In the middle ages, according to the tradition recorded in the Mirabilia Urbis, these spears were transformed into the statues representing the provinces of the Roman Empire, bells ringing on the outbreak of revolt, and the statue of the rebellious province revolving on its pedestal, so that the Senate had only to order out its legions. The sacred fire, in its turn, developed into a dragon couching below the ruins of the temple of Vesta, behind which rose the Church of Santa Maria Liberatrice or "de inferno" with its frescoes of the time of Paul the First (757-67).

Thus in this small group of the Regia, the temple of Vesta, and the sacred well in the intervening way, were assembled—and not all of them by chance—monuments connected with those natural phenomena which most impressed primitive man: earthquake, fire, and lightning.

If we look upon the Tholos as a granary, we can explain to a certain extent the presence of the large quantity of still which it contained, and the peculiar shape of the margin which forms the opening. Provided it was not subsequently converted into a cistern, the small gutter might have served as a filling trough, similar to the infundibulum of corn mills, which, says Vitruvius (x. 5), "subministrat molis frumentum."

Numa instituted the rite of Mola Casta in supplicating the gods. It was a sacrifice at which the Vestals made use of Mola Salsa, composed of far (grain) roasted and pounded (molitum) with salt, and then sprinkled over the victims (immolatio) at their consecration.

The grain used at this ceremony was the far which, according to Verrius, formed for three centuries the staple food of the Romans in the form of porridge: "Et grandes fumabant pultibus ollæ."

We may suppose that the sacrarium of Ops Consiva contained a subterranean store-pit protected from the heat and damp, similar to the primitive grain stores which to this day in Apulia serve their original purpose or have been converted into wine vats, from the derivation of the name, and we may make the same deduction from the fact that in the vast conflagration of 604 A.U.C. the sacrarium escaped destruction. We may also presume that of the two sacraria in the Regia no mention was made of that containing the granary, inasmuch as it was proof against fire.

On the space under which the sacred granary of Ops Consiva was buried must have existed the hall to which the Vestals and the Pontifex alone had access on the day sacred to the goddess.

The præfericulum or copper vase in the shape of a basin without handles was employed at the sacrifices, and perhaps also the secespita, an oblong knife with a round ivory handle adorned by gold and silver bands affixed by nails of Cyprus copper. The Flamen was not allowed to touch iron.

I look upon the tufa construction with the circular projection as the base of the altar. The small republican well adjoining may also have been used during religious ceremonies.

Saturn and Ops—sky and earth—were primitive divinities of the Romans, temples being dedicated to them at the foot of the Capitoline hill, originally called Mons Saturnus, or of the sky. It is due to a curious coincidence that the name of Aracoeli has been given to the church which now crowns the summit on which rose formerly the citadel of the Capitol.

Just as leguminous plants were used by the ancients as a manure for grain "Segetem stercorant fruges;" just as wood is food for the flames, so do ashes, the result of combustion, form food for the earth.

On the XVII. of the Kalends of Quintilius, or July, marked by the letters Q·ST·D·F (quando stercus delatum fas), the sweepings or ashes of the sacred fire of the temple of Vesta were carried half way up the Capitoline hill to an Angiportum which was closed by the Porta Sterocraria: "tantæ sanctitatis maiores nostri esse indicaverunt." This ceremony I look upon as a ritualistic manuring, ad tellurem alendam, referred to in the Fasti.

Just as, by separating, rearranging and bringing to view, in such a manner that they can be studied, the architectural fragments confusedly scattered about in the Forum, we are enabled to restore them to their respective monuments—to the temple of Castor and Pollux, the Arch of Augustus, to the Heroon of Julius Cæsar—and by this means the cornices and other architectural portions to the Regia; so, by rearranging those passages of ancient authors which have come down to us and refer to the buildings under examination, and by reviewing these passages in the light of new discoveries, we obtain fresh information and add greater importance to the buildings themselves.

The original buildings of the Regia and of the temple of Vesta were attributed to Numa Pompilius, who also instituted the priestly hierarchy, reserving supreme power for the king. After the king, in order of precedence, came: first, the Flamen Dialis; second, the Flamen Martialis; third, the Flamen Quirinalis. The Pontifex was appointed as "Moderator" of the religion and guardian of the Vestals.

Numa also instituted the twelve Arval brothers as well as the twelve Salii, warrior priests who in the month of March carried the sacred shields in procession through the streets of Rome.

Dressed in purple tunics and wearing helmets and belts of copper, they advanced keeping step to the sounds produced by striking the shields with short swords or rods. The dance consisted of steps and rapid gestures executed in time to the music with firmness and agility and the utmost grace. The selection of the number of twelve no doubt refers to the months of the year, which were recorded by nails driven into the walls of the sacred buildings—ut per eos numerus colligeretur annorum.

The months were also represented by twelve altars dedicated to Janus.

Tertullian considered this priestly organization so perfect that he attributed it to the devil. He states, moreover, that the Roman superstition, which began as far back as Numa, formed a simple cult. There were no lofty temples with idols and statues, but simple and occasional altars constructed of turf, in the service of which plain earthenware vessels were used, such as have recently been brought to light in the lower strata reached during the excavations in the Regia. These strikingly illustrate the proverbial simplicity of the "vasa Numæ" selected by that king for religious service, and mentioned by Persius. Compare also "capiduneulis iis quas Numa nobis reliquit."

We know from Festus that on the termination of the sacrifice in the Campus Martius of the offside horse of the winning chariot, its tail was hastily conveyed to the Regia so that the blood might drop into the fire.

The inhabitants of the Suburra and the Sacra Via contended among themselves for the head. Should victory rest with the former the head was attached to the Mamilian Tower, and when the latter won the head was placed against the walls of the Regia.

Festus tells us that the horse was sacrificed to Mars, "quem hostiæ loco quidam Marti bellico deo sacrari dicunt," which reminds us that the walls on which the inhabitants of the Sacra Via affixed the head were incised with the Fasti which also chronicled the warlike deeds of the Romans, a people martial above all things, who began the year with the month dedicated to Mars, "Mensium nomina fere aperta sunt si a Martio ut antiqui constituerunt numeres; nam primus a Marte," a custom which, according to a tradition handed down to us by Macrobius, goes back to the time of Romulus "Qui primum anni mensem genitori suo Marti dicavit."

It was not without design that of the four statues which are believed to have supported the tent of Alexander the Great, two should have been placed in front of the temple of Mars Ultor, and two in front of the Regia; though it is uncertain whether this was effected at the time of Augustus or after the fire of Nero.

The Equiria instituted by Romulus took place in the Campus Martius, a name also given to the part of the Celian hill to which the races were transferred when the Tiber overflowed the Campus Martius proper.

Polybius bears witness to the sacrifice of horses to Mars the god of war, and we also have a record of their consecration in those let loose by Julius Cæsar on the Rubicon.

To the early Romans war and agriculture were always complementary terms, as in the case of Seranus, so called because he was discovered sowing (serentem) when public honors were decreed him, and in that of Quinctius Cincinnatus who, when appointed Dictator, left the spade or the plow on his farm across the Tiber, to shake off the dust and wipe off the sweat; at the same time ordering his wife Racilia to fetch his toga from the hut.

That notice should be taken of these instances proves that with the birth of the Republic the type of the legislative and agricultural soldier was beginning to disappear, and that it merely recalled the time when "ipsorum manibus imperatorum colebantur agri," when every Roman general was a Seranus or a Cincinnatus without knowing it.

When C. Furius Cresinus was summoned before the Curule Aedile on a charge of sorcery (he was supposed to have transferred the fertility of his neighbor's land to his own) he came down to the Forum with the practical proof of his own industry as a farmer, bringing with him, according to Piso, sturdy peasants, well fed and dressed, perfect agricultural implements, heavy spades, powerful plows and well-fed oxen. "Quirites," he said, "I wish I could show you my thoughts as well, my watchings and the sweat of my brow." Cresinus looked on every citizen of Rome as a competent judge in matters agricultural, and was unanimously acquitted.

The annual sacrifice in the Campus Martius appears to have had as its object the propitiation of Mars as patron of agriculture for the head of the horse was girt with loaves of bread threaded, perhaps to imitate the appearance of a fillet, "panibus redimibant caput equi immolati idibus Octobribus in Campo Martio, quia id sacrificium fiebat ob frugum eventum." In its position on the walls of the Regia the head of the horse would also be in close proximity to the sacrarium of Ops Consiva, and we know that the Romans offered prayers to Mars pater or Marspitrem, beloved of the Accitani, a Spanish tribe, as an emanation of solar heat, "radiis ornatum," and that they sacrificed sucking pigs, calves and young lambs (suovitaurilia lactentia) for the prosperity of the harvest, vintage, herds, and shepherds. We also know that the Arval brothers sacrificed to the same deity. The Arval brothers were a rural priesthood whose insignia was a wreath of corn bound with white ribbons.

The view that the spears of the sacrarium represented Mars the peacemaker is upheld by the existence of the two bay trees at the entrance of the Regia, one of which "ex mediis ignibus" survived the burning of Rome 604 A.U.C.

The bay tree—messenger of peace—"ipsa pacifera, ut quam prætendi etiam inter armatos hostes quietis sit indicium," was looked upon as the guardian of the Cæsars and the Pontifices, "Janitrix Cæsarum pontificumque sola et domus exornat et ante limina excubat," and it is worthy of notice that the tree was called Regia before it was called Augusta, "laurus quæ cœpit augusta appellari."

With the help of this ancient tradition, we can form an estimate of the value of the adulation of the Senate, in causing the door of the house of Augustus to be hung with bay and crowns of oak, as he himself has recorded in the Ancyrean inscription:

ET LAURRIS POSTES ÆDIUM MEARUM (vestiti publice coronaq) VE CIVICA SVPER IANUAM MEAM FIXA EST.

That the Mars of the sacrarium was a Mars of Peace we have further indication in the custom of affixing to the walls of the Regia the heads of the mutinous soldiers who were sacrificed like the October Equus. In 708 A.U.C. Julius Cæsar caused two of them to be executed in the Campus Martius at the hands of the Pontifex and the martial Flamen, and their heads affixed to the Regia, καί γε κεφαλαί αυτῶν πρὸς τὸ βασίλειον ἀνετέθησαν.

Modern critics have stigmatized this action of Cæsar as a cruel and intentional parody of the sacrifice of the October Equus. The fact that we have only one record of the infliction of this punishment seems to me no reason for supposing it to have been an exceptional penalty, any more than the bleeding, which was resorted to as a disciplinary measure in the army.

Manlius Torquatus, during the war against the Latins (413 A.U.C.), caused his disobedient son to be sacrificed as a victim; and Valerius Maximus says, with reference to the military discipline of the Romans, "His piaculis, Mars imperii nostri pater, numen tuum propitiabatur."

On the expulsion of the Tarquins, the Senate dedicated to Mars their land which lay between the city and the Tiber known as the Campus Martius. It is worth noticing that the harvest from this land was collected and thrown into the Tiber, "quia religiosum erat consumere." It may possibly have been considered a sacrilege to partake of corn from land dedicated to Mars, always supposing that the consecration had not already taken place when Romulus instituted the Equiria on the same spot—then or subsequently called after Mars.

We know that the Lex Horatia granted to the Vestal Caia Terratia or Fufetia the additional privilege of marriage for having presented the Roman people with the Campus Tiberinus or Martius, and that the names of Caia Terratia and of Acca Larentia were, according to Aulus Gellius, celebrated in ancient records (the latter was nurse of Romulus, and mother of twelve sons who formed the original Collegium of the Arval brothers).

The custom of running to the Regia with the tail of the horse sacrificed in October in the Campus Martius finds a parallel in that still practised by the inhabitants of Guinea, of cutting off with a blow the tail of the oxen sacrificed as the vegetative spirit of grain, the virtues of which, incarnated in animal form, were supposed to reside in the tail; the last handful, or sheaf, of corn being looked on as the tail of its vegetative spirit, an idea exactly the opposite of the "first fruits" now offered by peasants to the Virgin.

The benefits derived from the autumnal sacrifice in this king's field and from the offerings on the sacraria of the Regia appear to have been shared by the entire people—"participandæ rei divinæ gratia."

Other important sacrifices were celebrated at Rome in the spring-time, when animals and plants are ready for their increase.

On the 1st of March, the commencement of the Romulean year, a fresh fire was lit on the altar of Vesta, ut incipiente anno cura denuo servandi novati ignis inciperet, while the old branches of bay were replaced by new ones on the Regia, the Curia, and the houses of the Flamines.

At the "hordicidia" the Curia flowed with the blood of thirty cows, "boves fordæ in est gravidæ, dictæ a fetæ," sacrificed to the pregnant earth "telluri plenæ victima plena datur." On these occasions, the calves extracted from the cows were burnt; while the ashes were mixed by the Vestals with the blood of a horse and distributed to the people at the Palilia festival.

These rites and the proximity of the sacrarium of Mars in the Regia to the Aedes Sacra of Vesta seem indistinctly to call to our mind the birth of the founder of Rome, son of Mars and Rhea Silvia, and cause one to fancy that, side by side with the cult of the sacred fire, others not less important, in connection with the mysteries of generation, may have been intrusted to the pure spirits of the Vestals, and our thoughts wander back to the time when man lived in harmony with nature, when every natural mystery was to him a sacred one.—Giacomo Boni, in The Nineteenth Century, by permission Leonard Scott Publication Company.

CONSTITUTION OF SULPHITES.

IT is now generally agreed that the true constitution of the sulphites is represented by the unsymmetrical formula $R.SO_2.OR$, as opposed to the symmetrical $SO.(OR)_2$. One interesting outcome of the former view is that there should be isomeric double sulphites, the one $R.SO_2.OR'$, and the other $R'.SO_2.OR$, and Schwicker and Barth have indicated the existence of such isomers in the case of sodium potassium sulphite. Dr. Fraps, however, after carefully repeating those experiments, has been driven to the conclusion that no

such isomerism exists in this case. That coincides with the views of Hantzsch, who holds that structural isomerism is unknown in inorganic bodies.—Am. Chem. Journal, through Nature, 61, 547.

SOCIABLE SPIDERS.

THE spider is the type of a solitary animal, which never shares its food with its companions nor extends any assistance to them. This horror of sociability is shown even at the moment when it is thinking of assuring the perpetuation of its species—an epoch at which it is not rare to see the females devour the males when the latter are unable to escape as fast as their legs can carry them, after performing the sexual act. Nevertheless, since in the sciences (although in natural history less than elsewhere) there are no rules without exception, we may mention a few examples in which these sanguinary instincts are in part abolished. In fact, there are a few species in which the rudiments of sociability are exhibited. Thus, the Clubiones fix their nests side by side under the same bark, and the Theridians, which live en masse under the glass of greenhouses, get their webs so entangled that several individuals sometimes advance simultaneously upon a prey, which remains the property of the first to arrive, without the others trying to pick a quarrel with him.

In other species, sociability is much more marked. These are met with especially in warm countries. Thus, Azzara tells us that in Paraguay there is a species of black spider, the Epeira socialis, of the size of a chickpea, of which the individuals live in a community of more than a hundred, and which construct in common a nest larger than a hat and suspend it from a large tree or the ridgepiece of a roof is such a way that it shall be sheltered above. From the periphery of this nest start a large number of coarse white threads 50 or 60 feet in length. Now that attention is attracted to this subject, it is probable that examples will multiply. M. Eugene Simon has observed in Venezuela various cases of sociability among a few species that are widely remote from each other. Such sociability, moreover, presents several degrees. Sometimes it is temporary, and limited to the time of reproduction, and sometimes it is permanent. In certain cases the work done is absolutely common and alike for all the individuals of the republic, while in others the common work does not exclude a certain amount of individual labor.

The first example to be mentioned is that of a spider which M. Simon has named Epeira Bandelieri. Ordinarily this does not appear to differ in its habits from other Epeiræ; but, at the moment of ovipositing, several females unite to construct, in common, upon a shrub, a large yellowish nest of woolly texture in which they inclose themselves in order to manufacture their cocoons and lay their eggs. The cocoon, which is of a very thick texture, is convex on one side and nearly plane on the other and secured to the walls of the incubating chamber by a very short pedicel. As many as ten cocoons are found in the chamber, and five or six females share the duties of maternity.

Sociability is completer in the Anelosimus socialis. Several hundred and often several thousand individuals of this species unite in order to weave a light and transparent web of close texture. This web, which is of indeterminate form, reaches large dimensions and is capable of enveloping an entire coffee tree. At first sight, this immense web recalls the work of caterpillars rather than that of a spider; but after the external envelope has been torn, it is seen that the interior is divided by partitions of the same material into very irregular compartments. Herein the spiders walk about freely, touch each other with their palpi when they meet, just as ants would do, and sometimes proceed to devour a prey of small size in common. The cocoons are rounded and formed of an iron-gray flocculent material. They are not pedicillate, but are fixed to the common web by a few threads forming a loose network.

The third type, which M. Simon observed in the Uloborus republicanus, is by far more perfect, since it offers upon the same web a common labor to which all the associates contribute, as well as an individual labor proper to each of them. Several hundred Uloborus live together, and spin between the trees an immense web formed of a central closely woven network upon which many individuals of both sexes, but principally males, stand side by side. This network is suspended by long threads diverging in all directions and attached to the surrounding objects. In the intervals of the meshes formed by these threads other Ulobori spin orbicular webs, which are afterward inhabited by but one individual. From time to time, a spider may be seen leaving the central group in order to seek in the upper cables a place adapted for the construction of its own orbicular web. The males are especially numerous in the central network, and it is here that the ovipositing is done. This operation appears to be performed almost simultaneously by all the females of the same colony. At this moment the males have disappeared, and the females having ceased to spin regular webs, remain upon the central network, at a few fractions of an inch from each other, each guarding its own cocoon in a state of complete immobility. The cocoon itself is of a most singular nature and resembles a piece of vegetable material that has accidentally fallen, rather than the work of a spider. It is an elongated body of a lustrous brown, narrow, truncated, somewhat sloping at the base and fixed to the threads by its angles (Fig. 3).

For the above particulars and the illustrations, we are indebted to La Nature.

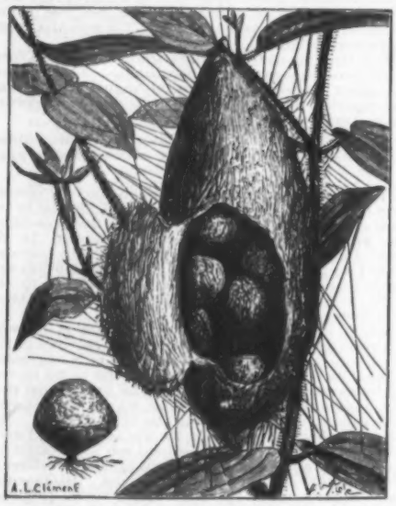


FIG. 1.—COCOONS OF EPEIRA BANDELIERI UNITED IN A BUNCH.

The external has been partially opened in order to show the interior. At the side is seen an isolated cocoon.

FIG. 2.—WEB OF ANELOSIUM SOCIALIS, AND ISOLATED COCOON.

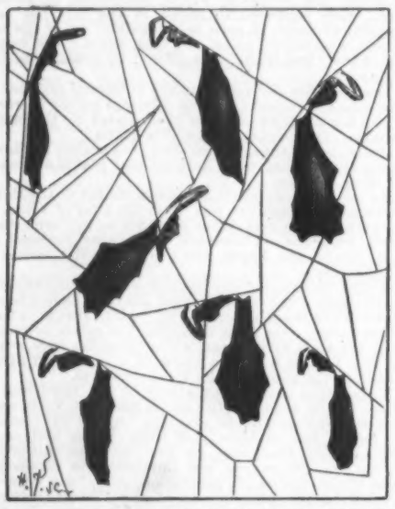


FIG. 3.—FEMALES OF ULOBORUS REPUBLICANUS WATCHING THEIR COCOONS.

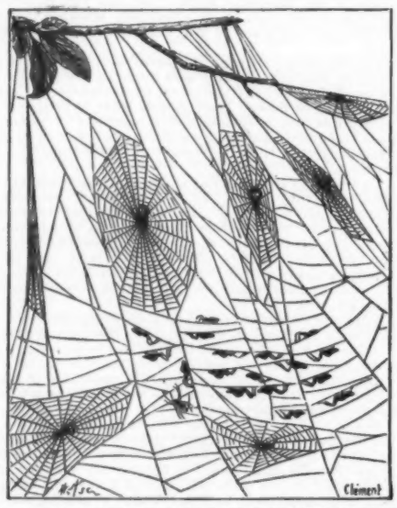


FIG. 4.—WEBS OF ULOBORUS REPUBLICANUS.

APPENDICITIS.

THE recent death of Mr. —— of complications resulting from an attack of appendicitis has excited renewed interest in that disease. He was a well known clubman, as well as a financier, and since his death men at the clubs have talked much of his death and of the disease of which he died. He was unusually vigorous, full habited, and fond of the good things of life. An hour or two before he felt the pain which medical men know is the herald of appendicitis, he was chatting with friends at the Union League Club. As the hour at which he usually dined approached, he went home to dress for dinner. While dressing, he felt the pain in the right side of his abdomen. That was the beginning of the end. The operating surgeon was called, the operation was performed and the appendix was found to be gangrenous. It was found that the gangrene had spread to the surrounding walls of the peritoneum. The operation was successful, but the septic poison was not to be withstood, and of that he died.

And this was the condition of an organ of an apparently healthy man's body, and the man didn't even know that he was in danger. Many persons are asking if there is no way by which one may be warned that his vermiform appendix is in an unhealthy condition. The medical men say there is. Because really eminent practitioners do not desire notoriety and are not in need of advertising, The Sun's authorities for what follows must be anonymous.

There appears to be no good reason why anybody should have appendicitis, because there appears to be no good reason why anybody should have a vermiform appendix. When men and women were apes or some other animal, there may have been a use for this organ, but, so far as the medical men know, it performs no function in the human body to-day other than to cause pain and make work for surgeons. According to the medical dictionaries, the appendix is a tube-shaped sac, about the size of a goose quill, which hangs from the blind intestine. At the top, or mouth, it is open, and the intestinal fluids, when conditions are healthy, flow in and out, as tides ebb and flow in an estuary of the sea.

The cause of appendicitis is an inflammation in the appendix. The inflammation may be produced from any one of a number of causes. The most frequent cause is constipation. It may also be caused by a particularly severe cold, very violent exercise or any one of many similar conditions. The appendix is surrounded, or walled in, by a series of tissues, the outside of which is the thick unyielding tissue of the peritoneum. When the inflammation sets in, it causes a swelling on the interior of the appendicular tube. The more aggravated the cause of the inflammation, the more violent the swelling. Usually the swelling occurs near the top or mouth of the appendix—the protuberances on each side of the walls of the tube meet, and the mouth of the appendix becomes closed. Then some of the germs which are indigenous to the bowels, and which float about through that locality at will in a healthy person, with the gases and fluids of the intestines, become confined in the appendix, and appendicitis is the result.

The warning of the disease is a pain in the right side of the abdomen, a few inches above and to the left of the groin. When one feels a pain in that place, the wisest thing to do is to call a physician at once. It may be that the pain is only indicative of what physicians call appendicular colic, or it may mean a well developed attack of appendicitis, according to the acuteness of the pain. Appendicular colic may be cured without an operation. The highest authorities on the subject say that a well developed attack of appendicitis necessitates an operation, although some assert they do not believe in operations at all, and that they have treated many acute cases with never a fatal result.

Appendicular colic is not appendicitis, because the inflammation in the appendix has not produced a swelling on the interior walls great enough to have closed the mouth of the appendicular tube. In such cases the approved treatment of authorities on the disease includes absolute rest and quiet for the patient, the taking of a sufficiently strong cathartic and the application to the abdomen immediately over the appendix of either ice bags or hot water bags. As for the outward application, the use of ice bags seems to be preferred to that of hot water bags, although in many cases the hot applications have accomplished the desired result, which is, of course, to reduce the inflammation.

The reason for the rest requirement is this. The appendix is so attached, to speak after the manner of a layman, that with every step one takes it strikes against the walls of the peritoneum. The flapping, of course, tends to increase the inflammation, and to make this impossible is why the absolute rest is prescribed. Under this treatment, if the case be really appendicular colic and not appendicitis, the patient recovers his usual health in from two to five days.

If the pain experienced be particularly acute, it is pretty safe to conjecture that it is caused by a sure enough attack of appendicitis. In that event the authorities appear to be agreed that there are two methods of treatment. Either method requires an operation. One operation involves the removing of the appendix. The other operation involves an incision into the appendix and a draining off of the contents. Which treatment shall be pursued depends entirely upon the surgeon selected to perform the operation, and also upon the acuteness of the attack. In some cases all the authorities agree that in the remo-

val of the appendix lies the only possibility of saving the life of the patient.

It is said that Drs. Bull, Walker, Weir and McBurney believe in the draining process whenever that may be possible. Other noted surgeons like Dr. Morris, Dr. Edebohls, Dr. Abbe and some others, believe that the removal of the appendix is the only thorough and satisfactory method of treating an acute attack of appendicitis. The draining process usually inolves the removal of the appendix at a subsequent operation, but those who believe in this method of treatment are not without their reasons for advocating it. All the authorities appear to be agreed that in itself the operation for removing the appendix is comparatively simple. It is said that from the operation alone not over 3 per cent. of the patients operated upon die. It is the resultant complications that produce death. In the case of Mr. ——, the operation was entirely successful. The physician who performed the operation is one of the most famous surgeons, not only of this country, but of the world. Death in Mr. ——'s case resulted from the poisoning which followed the operation and which, on account of the conditions, all the skill in all the world could not have combated.

Those who advocate the draining process at first say that it is easier to prevent septic poisoning or other complications by draining the appendix than by removing it. They hold that to puncture the appendicular tube and drain off the fluids and gases which cause the inflammation is safer, because it leaves the walls of the appendix intact except in the one place where the puncture is made and thus prevents septic poisoning from spreading to the peritoneum. It is said that if this treatment be followed the patient recovers from the attack of appendicitis, is able to recuperate, to get his entire system in a healthy condition and is then able to undergo the operation for the removal of the appendix with comparatively little danger of a fatal result.

These are the two most approved methods of treating appendicitis, and anybody who is afflicted may take his choice. A third treatment is that prescribed by those who do not believe in operations at all. There are several eminent practitioners in the city who assert that they have never lost a case of appendicitis and have never performed an operation. Those who do not believe in operations prescribe the treatment which includes the taking of catharties, outward applications to reduce the inflammation, and manipulation.

As to the question as to whether a man may be warned before his appendix becomes so badly affected as was that of Mr. ——, the authorities on the subject say that no appendix can become gangrenous without the person having several warnings before that stage is reached. One of the best known surgeons in New York said to a reporter of The Sun the other day:

"I am not familiar with the history of Mr. ——'s case, and I would not take a layman's description of it upon which to base any opinion or statement regarding it. Without knowing anything about it, however, I have no hesitancy in saying that if the facts were known Mr. —— had many warnings that his appendix was not in the condition it should be long before he was taken with the attack which proved fatal. I venture to say that if he were here to recall them he would admit recalling slight pains in the abdomen in the region of the appendix many times, but they were not in his opinion of sufficient importance to justify him in calling a physician. No appendix ever becomes gangrenous without some sort of a warning long beforehand. A safe course to follow, therefore, is to call a physician whenever one experiences pain in the region where the appendix is.

"I am a surgeon and fairly familiar with the history of appendicitis and all the complications resulting from operations for the removal of the appendix. But do you know what I would do if I thought I had appendicitis or something approaching it? I would immediately call some of the most eminent physicians in New York. I would ask them to make a careful diagnosis and watch the progress of the disease. When they said an operation was necessary I would have that operation performed as quickly as possible, and I would know then that it had not been performed a moment too soon or a moment too late. The trouble with relying upon the sole judgment of a surgeon is that he may not first have made it his business to discover the condition of all the other organs of the system that might be affected by an operation to remove the appendix, and then, again, he may be one of those surgeons who believe in operating whenever it is possible. Or, to put it in another way, he may not be one of the surgeons who believe in operating as little as possible. The opinion of the eminent physician is, therefore, not biased as the surgeon's may be. Janeway or Delafield or Draper, for instance, would not desire to perform an operation under any circumstances, and therefore you may depend upon it they would not order an operation until it was absolutely necessary."

Up to a few years ago, and with many of those unfamiliar with the causes of appendicitis to-day, the belief was that the disease was caused by secretions in the appendix, like seeds or foreign substances akin to them. As a matter of fact, operations have shown that not 3 per cent. of the cases of appendicitis have shown foreign substances in the appendix. The inflammation is almost invariably caused by something else than such foreign substances, as seeds, collar buttons, fish bones, pins, and the like. There is no particular reason, therefore, why anybody who is fond of fruit with seeds in it should not eat of it, provided he gives ordinary attention to the condition of his bowels.

In an article in The Medical Record of November, 1899, Dr. George M. Edebohls gave an exhaustive review of the history and literature of appendicitis. In the course of this article Dr. Edebohls says that the term appendicitis is a barbarism and is utterly unscientific. He says that "epityphlitis," "ecphyaditis" and "sooleocoiditis" have been proposed by Kuester, Morris and Gerster, respectively, as synonyms for appendicitis, but that term is too firmly established by long and universal usage, both among the profession and the laity, to be displaced at this late day. Going into the history of the disease, Dr. Edebohls says:

"Saracenus, in a letter dated August 28, 1642, describes an abscess in the right iliac region, with discharge of fecal matter and fourteen lumbricoid worms, which is possibly the most ancient clear case of appendicular abscesses on record. A number of similar cases were published during more than a hundred years following before Mestivier, in 1759 recognized appendicitis as a distinct entity. Mestivier incised an abscess in the right groin and found on autopsy, at the bottom of the abscess, the appendix vermiformis perforated by a pin. But the diagnosis of acute appendicitis was advanced more than by all previous knowledge combined by McBurney when, in 1889, he discovered and established the value of 'McBurney's point.'"

As to the relative frequency of appendicitis in the two sexes, Dr. Edebohls says that "the most remarkable and apparently irreconcilable statements are made by various investigators. While the belief is current that appendicitis affects males in larger proportions than females, Einhorn, in 18,000 successive autopsies, found perforating appendicitis in 55 per cent. of males and 57 per cent. of females; and Robinson in 128 autopsies as they came, found evidences of past peritonitis on or about the appendix in 66 per cent. of female and 56 per cent. of male bodies." Dr. Edebohls himself has found that 4 per cent. of all women have appendicitis. Dr. Edebohls also says that Finnell, in 1869, measured fifty male and fifty female appendices and found the appendix averaged one-half inch longer in women than in men.

As to the causative factors in cases of appendicitis, Dr. Edebohls mentions one authority as tracing a close analogy between quinsy and appendicitis, and two others as having discovered that the disease could be inherited. This discovery, according to Dr. Edebohls, was made by Atkinson and Bloomfield in 1895, and in 1896 Faisans declared that there was certainly such a thing as family appendicitis. Other authorities mentioned by Edebohls give gout, the grip and affections of the kidneys as contributory causes to the disease. As to foreign bodies in the appendix, Dr. Edebohls says:

"In former years foreign bodies in the appendix were considered under the head of the causes of appendicitis. In the light of modern views the permanent lodgment of foreign bodies in the appendix is more frequently the result than the cause of appendicitis."

Of the foreign bodies found, according to Dr. Edebohls, the most frequently met have been pins. Next to these have been found grape seeds, melon seeds, a grain of oat, cherry stones, prune stones, date seeds, orange seeds, a bean, huckleberry seeds, blackberry seeds, peanuts, a rifle cartridge and a globule of solder.

Dr. Edebohls is evidently a believer in the removal as a cure for the disease rather than any other treatment. After reviewing the treatment by incision he gives an extensive review of the surgery involving the removal of the appendix. As to this he says:

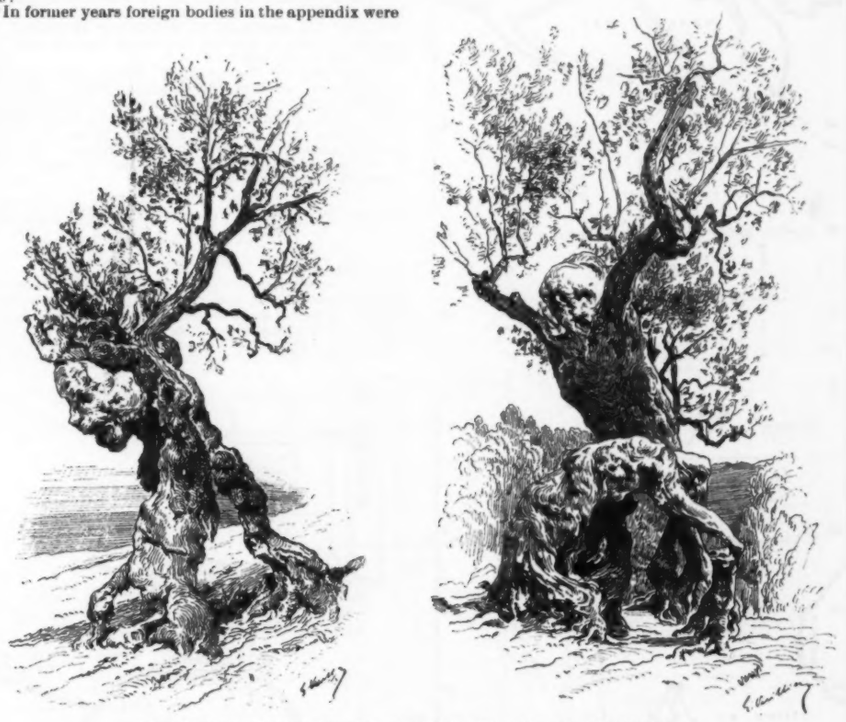
"The first recorded operation upon the appendix itself was planned by Dr. Mahomed and executed on August 24, 1883, by Symonds. Mahomed diagnosticated a stone in the appendix. Symonds removed the stone, three-quarters by one-half inch in size, through the ordinary incision for tying the external iliac artery, approaching the appendix from behind through peritoneal adhesions, opening the appendix, extricating the stone and then closing the appendix. The patient recovered and was cured of all his symptoms. In connection with this case Symonds becomes prophetic in relation to the future removal of the appendix in similar cases. I have found but three other instances of operation upon the appendix stopping short of its removal. Morton, on April 27, 1887, removed the larger part of an appendix containing a perforation. Sands, on December 31, 1887, closed a perforation of the appendix by suture.

"The first successful removal of the appendix was performed by Hall, on May 8, 1886, in an operation for the relief of a strangulated hernia. The appendix, with an abscess around it, was found among the contents of the hernial sac, tied off and removed. Morton, on March 19, 1888, and Sands, on April 17, 1888, performed the first successful appendicectomies for acute appendicitis, a correct diagnosis having been made in both cases before operation. To Morton belongs priority of performance, to Sands priority of publication. Other successful operations for acute appendicitis were performed during 1888, in the order named, by Hoffman, McBurney, Cutler and Weir. Hoffman removed the appendix through a median incision, and the case of McBurney was the first in which an acutely inflamed appendix full of pus was removed entire and without rupture.

"Thereafter removal of the appendix in acute appendicitis rapidly became a recognized and oft undertaken procedure. As early as 1889 McBurney reported seven appendicectomies of his own, with six recoveries and one death, and Morton four appendicectomies, with two recoveries and two deaths. Since that time scores of operators number their appendicectomies for acute appendicitis by the hundreds."—N. Y. Sun.

THE ABNORMAL OLIVE TREES OF MAJORCA.

THE olive tree, which is associated with our most cherished recollections, was one of the plants brought into cultivation at a very early period of man's history, and considerable doubts now exist as to its native country. The first mention of it is in the book of Genesis. The tree, which seldom exceeds 20 feet in height, is of slow growth, very tenacious of life and of great longevity—so great, in fact, that it is thought probable that the trees at present existing in the vale of Gethsemane are those which existed at the beginning of the Christian era. In the island of Majorca, into which the olive is thought to have been introduced by the Romans, the old trees assume most fantastic forms, and what is singular is that these monsters are rarely found isolated, but are grouped and occupy together certain spaces.



ABNORMAL OLIVE TREES OF THE ISLAND OF MAJORCA.

An examination of these trees reveals the fact that, in most cases, the center has disappeared, and the top is supported by fragments only. These fragments, in which the sap has continued to circulate, have developed isolatedly, and through a slow progression from without to within, have finally covered and cicatrized the wounds left by the disappearance of the central body. This is why, around the space previously occupied by the large tree trunk itself, we see an infinite number of young trunks of smaller dimensions, which, scraggy, contorted, and entangled, assume the most capacious and grotesque forms, which resemble in aspect the figures and faces of men and animals.

George Sand, in her "Hiver à Majorique," says, apropos of these trees:

"When a person takes a walk in the evening under their shade, it is very necessary for him to recall the fact that these are indeed trees, since, should he credit his eyes and imagination, he would be overcome with fright in the midst of all these fantastic monsters—some curving toward him like huge dragons with gaping mouth and outspread wings, others coiled like torpid bons, and still others embracing each other with fury, like gigantic wrestlers. Here is a centaur on a gallop, carrying upon its hindquarters something like a hideous ape; there is a nameless reptile devouring a panting hind; farther along, a satyr dancing with a he goat not so ugly as himself; and often it is a single, cleft, knotty, twisted and crooked tree that you would take for a group of ten distinct trees, and that represents all these various monsters and unites in a single head, which is as horrible as that of an Indian fetich, and is crowned with a single green branch like a crest."

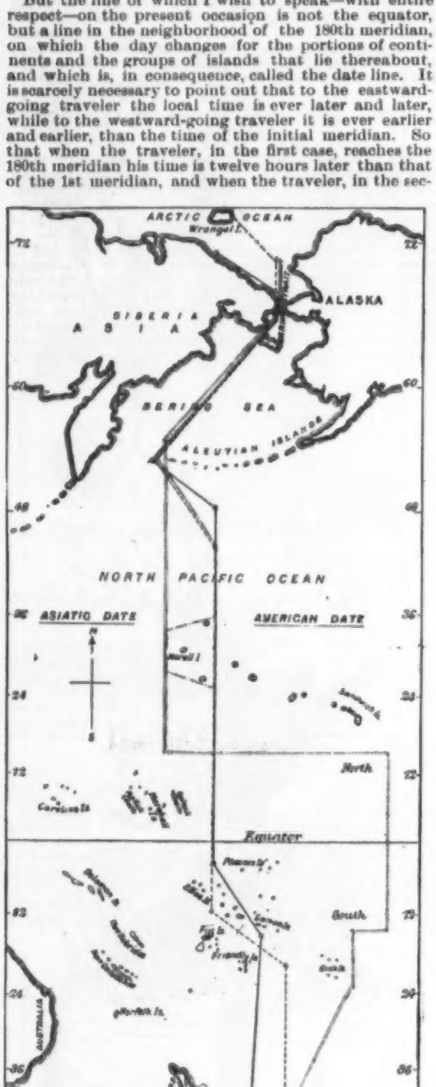
We represent, herewith, two of these grotesque forms of the olive tree, drawn from nature by M. Gaston Vuillier, and the sketches communicated by him to Le Magasin Pittoresque.

WHERE THE DAY CHANGES.

By Dr. A. M. W. DOWNING.

CROSSING the line for the first time must always be an experience of great interest to the traveler. Indeed, in former times the experience must have been a very disagreeable as well as an interesting one, on account of the unpleasant character of the ceremonies that were considered appropriate to the occasion, and in which the tyro took unwillingly somewhat too prominent a part. In the bad old times to which I refer, people were known sometimes even to speak disrespectfully of the equator.

But the line of which I wish to speak—with entire respect—on the present occasion is not the equator, but a line in the neighborhood of the 180th meridian, on which the day changes for the portions of continents and the groups of islands that lie thereabout, and which is, in consequence, called the date line. It is scarcely necessary to point out that to the eastward-going traveler the local time is ever later and later, while to the westward-going traveler it is ever earlier and earlier, than the time of the initial meridian. So that when the traveler, in the first case, reaches the 180th meridian his time is twelve hours later than that of the 1st meridian, and when the traveler, in the second case, reaches the same meridian his time is twelve hours earlier.



The Date Line.

The respective times of the two travelers (supposing them to meet on the 180th meridian) differ therefore by a day; that of the one coming from the Asiatic side being a day later than that of the one coming from the American side. When it is Thursday (suppose) on the American side, it is Friday on the Asiatic side. To set things right it is necessary for the traveler coming from the American side—in the case supposed—to skip Friday altogether, and to pass from Thursday to Saturday, while the traveler from the Asiatic side must have two "Fridays" in succession.

This is the practice followed on board ocean-going ships when crossing the 180th meridian, and it is as interesting an experience, in its way, as that of crossing the other "line" to which I have alluded above.

But are not these things written of in "Tramps Abroad," and other such literature? They need not, therefore, be further dwelt on here, as the matter to which I wish particularly to draw attention is the actual position of the date line in its course from the Arctic to the Antarctic regions. This is necessarily affected by the configuration of the continents, and by the groups of islands contiguous to 180th meridian. But it is obviously most convenient that the date line should follow that meridian as closely as political and geographical circumstances will admit. The positions of the line, as assigned by the different authorities I have been able to consult, are laid down on the accompanying map, which is reproduced, by permission, from the Journal of the British Astronomical Association, vol. x., No. 4.

The first thing that strikes one on looking at the map is the divergence of the different authorities. Notably the position given in Stieler's Hand Atlas is discordant, and, at the same time, deviates most from the 180th meridian. The atlas is, however, dated 1892, and this position may perhaps be considered, if not obsolete, at least obsolescent. The line marked "Wharton" is due to Admiral Sir W. Wharton, the hydrographer of the navy; that marked "Smith" is taken from an article in the Century Magazine for September, 1899, by Benjamin E. Smith; that marked "Davidson" is due to Prof. Davidson, of the University of California. It will be remarked that Wharton and Davidson agree very closely, except in one or two unimportant details, affecting a small group of islands. By adopting either of these lines, it may be assumed, with some confidence, that we know "Where the Day Changes," except, indeed, for the group of islands referred to, for which we must, I fear, for the present remain in doubt.

The further assimilation of the date line to the 180th meridian, though desirable, is difficult of realization, as the position of the line depends on the configuration of the parts of Asia and America concerned, and on the various circumstances which determine the direction in which the different groups of islands have intercourse with the outer world. But, judging from the past, progress in that direction, though slow, is sure, and will eventually give us a better approximation to a "straight" date line than we have at present.

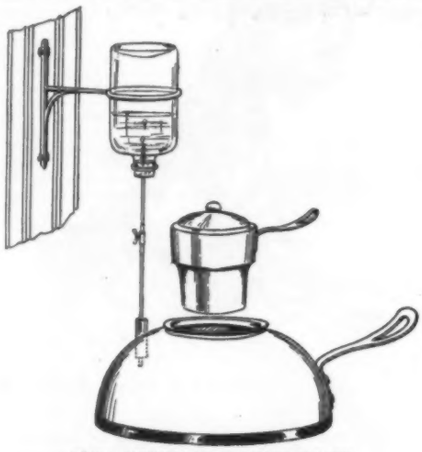
Would it be to inquire too curiously to ask where the twentieth century begins? As to when it begins, we have recently, somewhat to my astonishment, had a battle of the centuries, in which one at least of the crowned heads of Europe has taken a side, and has taken the wrong side too!

The answer to the question, Where does the day change? also answers the question, Where does the century begin? And, as we have seen, a fairly definite reply can be given by a reference to the map, except in the case of a group of islands. When does the century change for that particular group? Ah, well! it would puzzle even a crowned head to answer that question.—Knowledge.

SOME INEXPENSIVE HOME-MADE LABORATORY APPARATUS.

By F. N. STRICKLAND.

FOR the best reasons professionally and financially a pharmacist should make all the preparations he uses, that are possible to be made in a retailer's small laboratory—professionally, because this work gives him a higher standing among physicians and lay customers, besides giving him a desire for further thought and research; financially, because it saves him profits paid for the labor of others.



SELF-FEEDING WATER BATH.

Most drug stores have more or less "back room" that could be easily made into a satisfactory laboratory, but the seeming expense for apparatus undoubtedly deters many from making such an effort. To those druggists who are interested in their own manufacturing but who lack certain apparatus and utensils, perhaps this article may be of some value.

Many articles that will answer their purpose may be made by the pharmacist. In such manufacture one must be moderately skilled in bending and shaping glass tubing. To do this, grasp the tube on either side of the place where the curve or angle is desired, with the thumb and first two fingers of each hand; hold the tubing lengthways (not crossways) of a gas-jet flame, and slowly roll it between the fingers to heat it evenly. When the glass begins to soften discontinue this rolling movement and slowly and carefully bring both hands toward each other, at the same time pulling down gently until the proper curve or angle is reached. Then remove the tube from the flame and allow it to cool. If these directions are carefully followed, the bend will be full and perfect, while if less care or too much haste is used, the tubing will flatten on top and crinkle underneath the bend. A very few trials will make one quite an adept, and enable him to make steam atomizer fittings, etc.

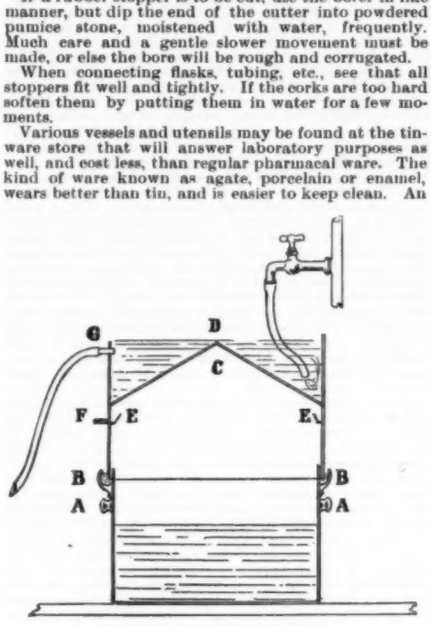
Now there will have to be perforated corks and rubber stoppers. It is decidedly essential that these stoppered connections be neatly and properly fitted, to avoid escape of vapors or gases and to prevent accident caused by their ignition.

In boring holes through cork, use a cutter that is smaller than the diameter of the tubing to be used, and by a rotating movement and gentle pressure, carefully cut the hole through the cork. When this is done, use a small, round file or a piece of moderately coarse sand paper wrapped around one of the borers, or lead pencil, to smooth off the rough, inner surface until it fits about the tube nicely. In place of using a regular cork cutter, excellent results may be obtained by gradually forcing a pointed, round file through the cork by a rotary motion, then carefully and smoothly filling out the hole until a perfect fit is obtained.

If a rubber stopper is to be cut, use the borer in like manner, but dip the end of the cutter into powdered pumice stone, moistened with water, frequently. Much care and a gentle slower movement must be made, or else the bore will be rough and corrugated.

When connecting flasks, tubing, etc., see that all stoppers fit well and tightly. If the corks are too hard soften them by putting them in water for a few moments.

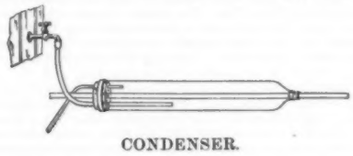
Various vessels and utensils may be found at the tinware store that will answer laboratory purposes as well, and cost less, than regular pharmacal ware. The kind of ware known as agate, porcelain or enamel, wears better than tin, and is easier to keep clean. An ordinary steam tea-kettle, such as housewives use, is a very useful article in a drug store for heating water to wash utensils. An inspection of such hardware stock will suggest many things that might be used to advantage.



DISTILLING APPARATUS.

As a water bath, what is called a "double boiler" of such size as best will suit, answers excellently. The styles may vary from that shown in the accompanying illustration, but the principle is the same. These baths are suitable for many operations and cost from 35 cents to $1.50, according to size and grade. The upper pot is fitted with a cover, and is made to fit down into the lower one. They usually fit well, and when in use very little steam escapes from the bath, so the evaporation in the lower pot is consequently slow.

The illustration represents the style of bath used by the writer together with an original appliance to prevent complete evaporation of the water, when not closely watched. This refilling attachment may be applied to the side or outer ring of a regular water bath as follows: Fit a half gallon bottle with a perforated cork, through which has been passed a suitable piece of glass tubing about 4 inches in length. Slip over the outer end of this tube 2½ or 3 feet of rubber tubing, and to the end of this attach another piece of glass tubing seven inches long. Fill the bottle with water, insert the stopper, with the tubing, close the rubber tube by means of a pinch cock, and hang up the bottle in an inverted position and just high enough so that the end of the lower glass tube will pass through



CONDENSER.

a hole which previously has been made in the side or top of the bath, and be just below the surface of the water in it; open the pinch cock and, as often as the water is evaporated in the bath below the end of the glass tube, just that amount of water will be replaced from the bottle, thus preventing complete evaporation and consequent overheating the dish.

To make and have clean, well keeping preparations, distilled water is often necessary.

The simple apparatus here figured is just adapted to this, and I can heartily recommend it to other druggists for its practicability, cheapness and convenience. Its cost will be from $1.75 to $2.50, and it is capable of distilling from 2 to 3 gallons with one filling.

Take two clean, empty five-gallon alcohol or glycerin cans to a tinsmith and direct him to cut off the top of one can, and for convenience in lifting about solder two handles, *A*, one on either side. Within 2 inches of the top of this can, solder around the four sides a tin trough, *B*, 1½ inches deep and 1 inch wide. This is to hold water to prevent the escape of vapor, when all is fitted together. Cut off the top and bottom of the second can, and fit the bottom of it over the top of the first can. Now crimp and solder a pyramid-shaped roof, *C*, 5 inches deep, and made just the size so as to be soldered inside this can, so that the point or top of the roof will be 2 or 3 inches below the top edge of the can, *D*. Solder around the inside of this can, 1½ inches below where the roof is joined, a trough, *E*, to catch the condensed vapor which will run around and flow

out of the escape pipe, *F*, into the tube to the receiver. This pipe or tube is made of tin and is fitted to the escape pipe and should be about 6 feet long. If more perfect cooling or condensing in this long tube should be desired, run the pipe through a small, oblong tin box, which may be packed with ice or cooled by running water, on the very principle of the cooling process in the top can, which is as follows: In one side or corner of the upper can solder in a tin tube, 1 inch in diameter, for a water escape, *G*, to which may be attached a piece of rubber tubing or hose and the overflow conducted into a sink.

The manner of operating the still is evident from inspection of the diagram. One must be careful to fill up the outside trough with water to prevent escape of steam.

This still is useful for recovering alcohol from the mare after making tinctures, etc., by putting this mare into the lower can, with considerable water, and using just enough heat to recover the alcohol. Or the menstruum in several mares may be expressed and saved, until enough is saved to make the recovery worth while. This simple apparatus is not original with me. It was brought to my attention by a brother druggist several years ago, and I have since learned that a similarly contrived apparatus was in the market many years ago.

If the pharmacist has on hand a cylindrical percolator of 500 to 700 c.c. capacity, a very good condenser may be quickly constructed, with little cost and labor, as follows: Fit both ends of the percolator with good corks. In the larger cork cut 3 holes, and in the smaller 1. Through the center hole of the larger cork pass a piece of stout glass tubing 1¼ inches in diameter and long enough to project 5 inches from both ends. In the upper hole fit another glass tube 6 inches long and ¼-inch in diameter, so that it will just extend inside the cork. To the outer end of this tube attach rubber tubing enough to carry the overflow into a suitable receptacle. The lower hole in the cork is fitted with another piece of glass tubing, of a somewhat larger diameter than that of the escape tube, and it must be long enough to extend into the percolator at least one-third of its length. The other end of this tube is connected by means of tubing with a faucet or tank, which furnishes the water for cooling the condenser.

Many useful ideas may be formulated and improved upon by the ingenious pharmacist who keeps his eyes open while visiting other stores.—The Druggist's Circular.

Coloring Tin Solder.—When brass has been soft soldered, the seam is often conspicuous by its white color, injuring the appearance of the whole article. By coloring the seam this evil may be obviated. Buchner recommends the following: Apply a saturated solution of blue vitriol (19 parts of copper sulphate in 35 parts of water) as the solder and touch the seam with an iron wire. Thereby the spot is coppered; the operation may be repeated various times. In order to produce a yellow color apply to the coppered place a mixture of 1 part of a saturated zinc-vitriol solution (1 : 1) in 2 parts of a saturated blue vitriol solution and rub with a zinc bar. The resulting color can still be improved by polishing or weak gilding.—Die Werkstatt.

THE JAPANESE BATTLESHIP "ASAHI."

THE plans of the battleship "Asahi," built for the Imperial Japanese Navy by Messrs. John Brown & Company, Limited, at their Clydebank establishment, are given herewith.

The principal dimensions are as follows:

	Feet.	Inches.
Length between perpendiculars ...	400	0
Length over all	425	6
Breadth, extreme	75	2½
Depth, moulded.	43	7⅛
Normal mean draught of water....	27	3
Displacement	15,200 tons.	
Indicated horse-power..	15,000	

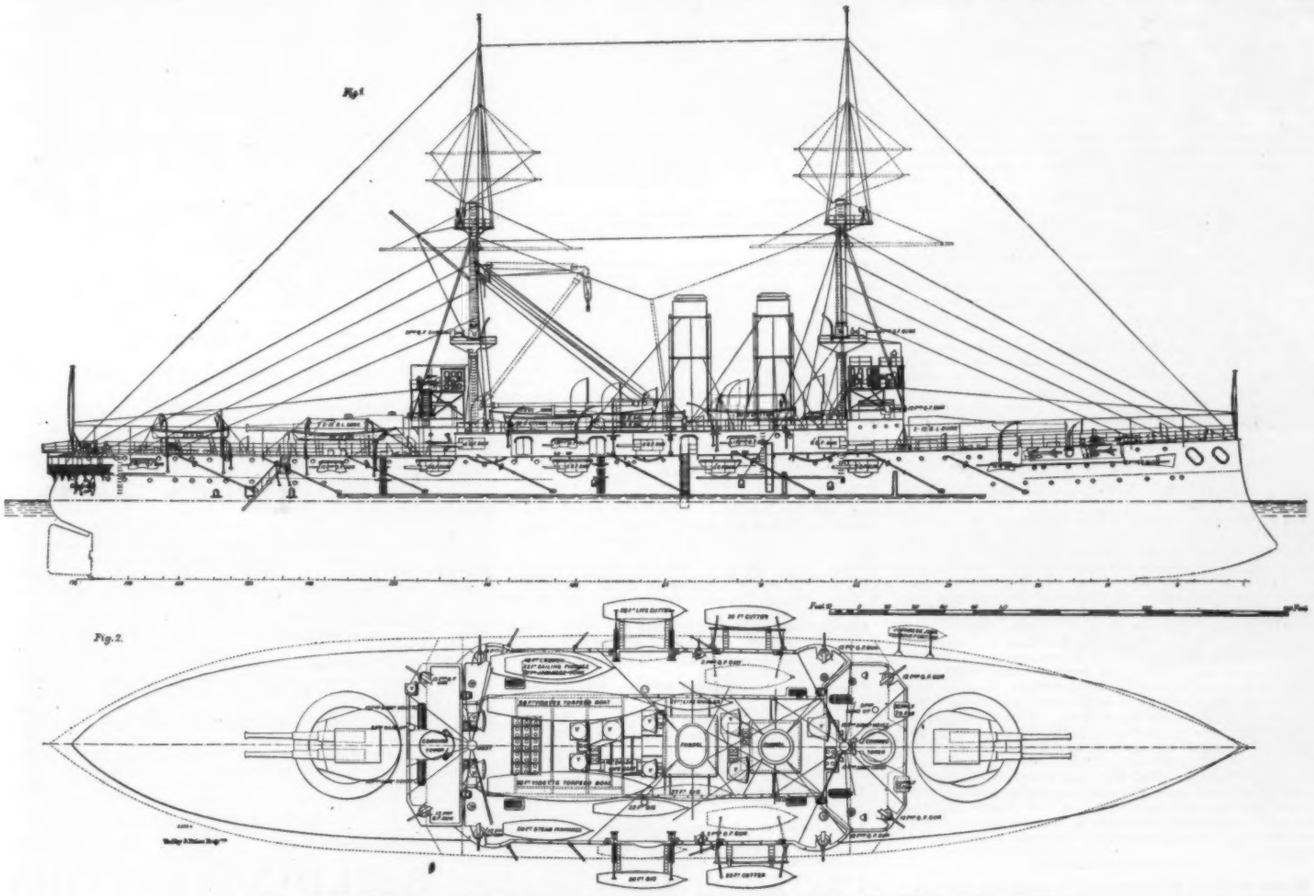
Four 12 inch guns of the most modern type are mounted in pairs in two barbettes, one forward and the other aft, on the middle line of the vessel, each pair commanding an uninterrupted arc of training of 240°. The manipulation of the machinery and all the operations of loading and laying the guns are performed by hydraulic power; the loading can be performed with the guns in any position of training. The guns and gunners are well sheltered by means of heavy armored shields, which revolve with the turntables. The secondary armament consists of fourteen 6-inch quick-firing guns, each mounted in a separate casemate; twenty 12-pounder, eight 3-pounder, and four 2½-pounder quick-firing guns, with four submerged torpedo tubes in two compartments, one forward and one aft.

Great care has been bestowed upon the arrangement of the protective material. There is a main belt extending for a length of 250 feet amidships, the total depth of this belt being 8 feet 2 inches, and it is intended that when the ship is floating at the normal water line the lower edge of the armor will be 5 feet 6 inches below water, and the upper edge 2 feet 8 inches above water. The maximum thickness of this belt is 9 inches. The central citadel of armor is completed by transverses or bulkheads extending obliquely across the ship and inclosing the bases of the barbettes which protect the positions for the heavy guns. Forward and aft of this main belt the protection of the water-line region of the ship is completed by armor carried to the bow and stern. Above the main belt the sides from lower to main deck are covered with armor of a thickness of 6 inches; this belt extends for a length of 250 feet, and is completed by oblique transverses at the ends as described for the main belt. Armored doors are fitted in these transverses for affording convenient means of communication along the deck when in port. The protection of the vitals of the ship is rendered the more secure by a heavy protective deck extending all for and aft, and sloping away from the under side of the main armor belt. The protection to the armament is arranged in a very thorough manner. For the 12-inch guns at the extremities circular barbettes rise from the protective deck to a height of 22 feet 4 inches above the normal water line; these barbettes are plated with armor of a maximum thickness of 14 inches. Each 6-inch quick-firing gun is inclosed in a casemate with an armored front 6 inches thick. The forward conning-tower is composed of 14-inch armor, and the after tower of 8-inch armor. The whole of the armor plating was manufactured by Messrs. John Brown & Company, Limited, Sheffield, and is of the highest quality procurable, every plate having been treated by the improved Harveyed nickel-steel process, except those for the conning tower, where experience shows that the curvature of the plates is too great to enable this process to be sucessfully employed; these plates are consequently made of ordinary Harveyed steel. As a protection against attacks from torpedoes, a broadside net defense is fitted for length of about 300 feet amidships; the nets are supported by steel booms, and when not in use stow on a convenient shelf worked round the sides.

The ship is propelled by two sets of three-cylinder triple-expansion-engines. Each of the two sets is designed to develop 7,500 indicated horse-power, giving a combined indicated power of 15,000. Steam is supplied by 18 water-tube boilers of the Belleville economizer type, working at a pressure of 300 pounds, which is reduced at the engines to 250 pounds. The diameters of the high-pressure cylinders are 32½ inches, of the intermediate-pressure cylinders 52 inches, and of the low-pressure cylinders 85 inches, all having a stroke of 4 feet.

The vessel left Portsmouth Harbor on Tuesday, March 20, and after compasses had been adjusted, a few low-speed runs on the measured mile at Stokes Bay were made with the following results: Mean speed, 6·09 knots, indicated horse-power, 613; speed, 9·28 knots, indicated horse-power, 1,610; and for a speed of 13·06 knots the indicated horse-power was 4,355. On Wednesday, March 21, the vessel ran her coal consumption trial, with the result that at 12,947 indicated horse-power the consumption only averaged 1·59 pounds per indicated horse-power per hour. The contract stipulated that this trial should take place with a development of power of at least 12,200 horses, so that with the high power developed the low coal consumption is all the more creditable. But for the fact that the wind and sea were both too high, a speed trial at this power would have been made over a 12-knot course between Start Point and Berry Head. From the records taken, however, it appeared certain that the speed at this power may be fairly taken to be about 17¼ knots.

The full-speed trials took place on March 23, on the selected deep-water course between Berry Head and Start Point, a distance of 12·25 knots. Four runs were made in alternate directions, the first and third being in the teeth of a northeasterly gale. Notwithstanding this, the mean speed realized was 18·3 knots. The speeds on the four runs were as follows: First run, 17·92 knots; second run, 18·08 knots; third run, 18·65 knots; and the last, 18·30 knots; the mean of means being 18·30 knots, as before stated, with a mean indicated horse-power of slightly over 16,000. After the full speed trial, circles were made to port and starboard with each steam-steering engine, the vessel meanwhile being at full speed. Maneuvering with the hand-steering wheels was also successfully carried out at a speed of 15 knots. The usual stopping, starting and reversing trials were made on the return voyage to Spithead, the return passage being made at a speed of 17 knots. The Japanese government is to be congratulated on this latest addition to its fleet. The trials just concluded prove the "Asahi" to be as fast as



THE TWIN SCREW BATTLESHIP "ASAHI," FOR THE IMPERIAL JAPANESE NAVY.

any battleships approaching her in size, while with her large displacement it is obvious that the offensive and defensive qualities of the ship are unexcelled.—Engineering.

PRECIOUS STONE INDUSTRY IN THE UNITED STATES.

THE condition of the precious stone industry in the United States during the fiscal year ending June 30, 1899, is summed up by Mr. George F. Kunz in his report upon this subject to the United States Geological Survey as follows:

Some of the salient features of the year are the finding of rock crystal at Makelumne Hill, Cal., of such purity and size as to almost rival the Japanese, and the successful cutting of these in the United States up to 7 inches in diameter; the increased output of Fergus County, Mont., sapphire mines, and the yielding of fine blue gems up to 2 carats each, and the discovery of a new locality where the stones are more varied in color than those of any known locality; the continued output of the New Mexican turquoise mines and the opening up of mines in Nevada; the finding of magnificent green and other colored tourmalines at Paris Hill, Me., and Haddam Neck, Conn.; the increased sale of Australian opal; greater use of all the fancy or semiprecious stones; the greater importation of uncut diamonds, and the increase of the diamond-cutting industry in the United States; the unprecedented increase in the importation of cut diamonds; the revival of the precious stone industry in the United States, and the positive great future advance in the price of pearls and emeralds, and the advance in the price of diamonds.

ADVERTISING AMERICAN EXHIBITS AT PARIS.

THE following has been received from Consul-General DuBois, of St. Gall:

If American firms having exhibits at Paris would send to the consular officers a few neatly printed cards, mentioning the character of their exhibits and extending a cordial invitation to the bearer to examine them while visiting the exposition, I am quite sure that all consular officers of the United States would see that these cards are placed in the hands of merchants residing in their districts who are likely to be interested in the exhibits to which they relate, and who will desire to examine them should they visit the exposition. One large shoe dealer said to me recently:

"I am going to Paris to examine the American shoe exhibit, to see if I can make arrangements with some good firm to ship shoes to Switzerland. Do you know what firms are to exhibit?"

This same spirit of inquiry can be found among the Swiss dealers in hardware, bicycles, automobiles, food stuffs (such as ham, bacon, dried fruit, potted meats, canned fruit), agricultural machinery, photographic supplies, office furniture, and many other articles that can be imported into this country with success.

MEXICAN CATTLE INDUSTRY.

CONSUL GRIFFITH, of Matamoras, under date of March 23, 1900, says:

Mexico contains a great many haciendas admirably adapted and almost exclusively devoted to the raising of cattle. A fact which is attracting general interest here is that every season shows an improvement in the care taken of the animals and also in the class imported. The stockmen throughout this country are taking such an interest in this direction and have imported so many pure-bred cattle from the United States that on many haciendas one may find animals which compare favorably with those on noted breeding farms in the North. In former years they consisted exclusively of the old, long-horned, Spanish and Mexican types, which have large bones and frames and long legs, but are deficient in flesh. This deficiency is certainly not due to the country, for the climate, grass, water, and general topography are decidedly favorable to animal growth and comfort; and while it is a generally recognized fact that Mexican stock is inferior to United States animals, it is the prevailing opinion that a cross between the pure blood of the North and the cow acclimated here produces a large, healthy, vigorous offspring with an unusually compact muscular development.

Wagon Factory in Chemnitz.—A company has been organized in this city, with a capital of $3,570,000, to build wagons, carriages, etc. Consuls have often called attention to the opportunities offered in this empire and all over Europe for the sale of American wagons, carriages, and vehicles of all kinds. The success achieved at home is a guaranty that our products, if properly pushed, would find ready and profitable sales abroad. The roads here are remarkably even. The wear and tear, so heavy in parts of our country, have been minimized, if not entirely eliminated. This factory will furnish a great opportunity to our manufacturers of wagon and carriage tools and machines; also to makers of wood-working tools and machines. In these lines, we are said to excel. If catalogues containing price lists are sent to this consulate, care will be taken to see that they are properly distributed. The catalogues should, if possible, be printed in German; luckily, this is not absolutely necessary, as most merchants and manufacturers here read English. Before the factory is finished, before it can turn off a single wagon or carriage, our manufacturers or agents ought to make a supreme effort to effect sales of vehicles here. —J. F. Monaghan, Vice-Consul at Chemnitz.

Stone-like Coating for Wood.—According to the Süddeutsche Bauzeitung, take 50 parts of rosin, 40 parts of finely crushed chalk, 50 parts of fine white and sharp sand, 4 parts of linseed oil, 4 parts of native cupric oxide, and 1 part of sulphuric acid. First heat rosin, chalk, sand and linseed oil in an iron kettle, next add the oxide and, with care, the sulphuric acid, mix all very carefully and coat the paint with the mass while still hot, by means of a strong brush. If the mixture is not liquid enough, add a little more linseed oil.

NEW BOOKS

Accumulators. How Made and Used. An Elementary Handbook for the use of Amateurs and Students. Edited by Percival Marshall. 12mo, cloth, 80 pages, 40 illustrations. New York, 1899. ..... $0 50

Agriculture. Principles of Agriculture. A Textbook for Schools and Rural Societies. By L. H. Bailey. 16mo, cloth, 300 pages, illustrated. New York, 1899 ..... $1 25

Air-Brake Catechism. For Firemen, Engineers, Air-brake Instructors, Shop Men, and all branches of Railroad Men. By Robert H. Blackall. 12mo, cloth, 240 pages, illustrated. New York, 1899 .. $1 50

Alaska and the Klondike. A Journey to the New Eldorado, with Hints to the Traveler and Observations on the Physical History and Geology of the Gold Regions, the Conditions of and Methods of Working the Klondike Placers, and the Laws Governing and Regulating Mining in the Northwest Territory of Canada. By Angelo Heilprin. Fully illustrated from photographs and with a map of the gold regions. 12mo, cloth, 315 pages. New York, 1899. ..... $1 75

Astronomy. The Elements of Practical Astronomy. By W. W. Campbell. Second edition revised and enlarged, 8vo, cloth, 264 pages. New York, 1899. ..... $2 25

Birds. A Dictionary of Birds. By Alfred Newton, assisted by Hans Gadow, with contributions from Richard Lydecker, Charles S. Roy, and Robert W. Shufeldt. 8vo, cloth, illustrated, 1,088 pages. London. $5 00

Birds. The First Book of Birds. By Mrs. Harriet Mann Miller. With 8 colored and 12 plain plates, and 20 figures in the text. 12mo, cloth, 149 pages. Boston, 1899. ..... $1 00

Botany for Beginners. By Ernest Evans. 16mo, cloth, 200 pages. New York, 1899. ..... $0 75

Building Construction and Superintendence. By F. E. Kidder. Part II., Carpenter's Work. Second edition, 8vo, cloth, 544 pages, 594 illustrations. New York, 1899 ..... $4 00

Cement. Portland Cement. Its Manufacture, Testing and Use. By D. B. Butler. 8vo, cloth, 360 pages, 85 illustrations. London, 1899. $6 00

Chemistry. The Arithmetic of Chemistry. Being a simple treatment of the subject of Chemical Calculations. By J. Waddell. 12mo, cloth, 133 pages. New York, 1899. ..... $1 00

Chemistry. Descriptive General Chemistry. A Textbook for Short Course. By S. E. Tillman. 8vo, cloth, 439 pages. New York, 1899. ..... $3 00

Clay Modelling for Schools. A Progressive Course for Primary Schools and Grammar Grades. By Anna M. Holland. 8vo, cloth, illustrated, 21 pages, 19 plates. Boston, 1899. ..... $1 00

Cyanide Process. Practical Notes on the Cyanide Process. By F. L. Bosqui. 8vo, cloth, illustrated, 201 pages. New York, 1899. $2 50

Decorative Designs of all Ages, for all Purposes. With numerous engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London, 1899. ..... $0 50

Dams. The Design and Construction of Dams, including Masonry, Earth, Rock-Fill, and Timber Structures. Also the principal types of Movable Dams. By Edward Wegmann. Fourth edition, revised and enlarged. Quarto, cloth, 250 pages of text, 88 folding plates. New York, 1899. ..... $5 00

Electrotyping. A Practical Treatise on the Art of Electrotyping by the latest known methods. Containing historical review of the tools and machinery required, and complete instructions for operating an Electrotyping plant. By C. S. Partridge. 12mo, cloth, 149 pages, illustrated. Chicago, 1899. ..... $1 50

Engineer's Handy-Book. Containing Facts, Formulæ, Tables and Questions on Power. Its Generation, Transmission and Measurement, Heat, Fuel and Steam, the Steam Boiler and accessories, Steam Engines and their parts, the Steam Engine Indicator, Gas and Gasoline Engines, etc., etc., etc. By Stephen Roper. Fifteenth edition, revised and greatly enlarged by E. R. Keller and Clayton W. Pike. 12mo, 844 pages, leather pocketbook form. Philadelphia, 1899. ..... $3 50

Fertilizers. The Source, Character and Composition of Natural, Homemade and Manufactured Fertilizers, and suggestions as to their use for different crops and conditions. By E. B. Voorhees. 12mo, cloth, 335 pages. New York, 1899. ..... $1 00

Fields, Factories and Workshops; or, Two Sister Arts, Industry and Agriculture. By P. Kropotkin. 8vo, cloth, New York, 1899 ..... $3 00

Foundry Cupola. The Cupola Furnace; a Practical Treatise on the Construction and Management of Foundry Cupolas. By E. Kirk. 12mo, cloth, 361 pages, illustrated. Philadelphia, 1899. ..... $3 50

Heat for Advanced Students. By Edwin Edser. 12mo, cloth, 470 pages, fully illustrated. London and New York, 1899 .. $1 00

Hydraulic and Placer Mining. By R. B. Wilson. 12mo, cloth. New York, 1899. ..... $2 00

Heat and Heat Engines. A study of the principles which underlie the mechanical engineering of a power plant. By F. R. Hutton. 8vo, cloth, 553 pages, illustrated. New York, 1899. ..... $5 00

Hop. The Hop, Its Culture and Cure; Marketing and Manufacture. A practical handbook on the most approved methods in growing, harvesting, curing, and selling Hops, and on the use and manufacture of Hops. By Herbert Myrick. Profusely illustrated, 12mo, cloth, 290 pages. New York, 1899. ..... $1 50

Indicating the Refrigerating Machine. The Application of the Indicator to the Ammonia Compressor and Steam Engine; with practical instructions relating to the construction and use of the Indicator, and rendering and computing Indicator Cards. By G. T. Voorhees. New York, 1899. ..... $1 00

Insects. Our Insects, Friends and Foes. How to Collect, Preserve, and Study Them. By Belle S. Cragin, A.M. With 255 illustrations, 377 pages, 8vo, cloth. New York, 1899. ..... $1 75

Insects. Their Structure and Life. A Primer of Entomology. By George H. Carpenter. 12mo, cloth, 404 pages, 182 illustrations. London, 1899. ..... $1 75

Kinematics of Machinery. By John H. Barr. 8vo, cloth, 313 figures, 247 pages. New York, 1899. ..... $2 50

Landscape Gardening. How to Plan the Home Grounds. By S. Parsons, Jr. With illustrations, 12mo, cloth, 240 pages. New York, 1899. ..... $1 25

Landscape Gardening. Treatise on the General Principles Governing Outdoor Art; with sundry suggestions for their application in the commoner problems of gardening. By F. A. Waugh. Illustrated, 12mo, cloth, 152 pages. New York, 1899. ..... $0 50

Lead. The Metallurgy of Lead and the Desilverization of Base Bullion. By H. O Hofman. Fifth edition, revised, rewritten, and enlarged. 8vo, cloth, 539 pages, illustrated. New York, 1899. ..... $6 00

Locomotive Engineering. A Manual of Locomotive Engineering, with an Historical Introduction. A Practical Text-book for the use of Engine Builders, Designers, and Draughtsmen, Railway Engineers, and Students. By Wm. F. Pettigrew. With a section on American and Continental Engines by Albert F. Ravenshear. With 9 plates and 280 illustrations. 8vo, cloth. Philadelphia, 1899. ..... $6 50

Machine Design. Part II. Form, Strength, and Proportions of Parts. By Forrest R. Jones. 8vo, cloth. 353 pages. Illustrated. New York, 1899. ..... $3 00

Mathematics. First Course in Mathematics. (The Home Study Circle.) Edited by Seymour Eaton. Mechanics' Bids and Estimates, Mensuration for Beginners, Easy Lessons in Geometrical Drawing, Elementary Algebra, A First Course in Geometry. From the Chicago Record. 18mo, cloth. 340 pages. Illustrated. New York, 1899 ..... $1 00

Metallurgy. Handbook of Metallurgy. By Dr. Carl Schnabel. Translated by Henry Louis. In two volumes. 8vo, cloth, 1,002 pages, 927 illustrations. London, 1899. ..... $10 00

Modern Mechanism. A Resume of Recent Progress in Mechanical, Physical, and Engineering Science. By Charles H. Cochrane. New and enlarged edition. Illustrated. 12mo. cloth. Philadelphia, 1899. $1 50

Naval Architecture. A Textbook of Theoretical Naval Architecture. By E. L. Atwood. 12mo, cloth. 295 pages. Illustrated. London and New York, 1899. ..... $2 50

Optics. A Treatise on Photographic Optics. By S. R. Cole. 8vo, cloth, illustrated, 320 pages. New York, 1899. ..... $2 50

Photography. Amateur Photography. A Practical Guide for the Beginner. By W. I. Lincoln Adams. 12mo, cloth, 135 pages, illustrated. New York, 1899. ..... $1 25

Picture Framing. Mounting and Framing Pictures. With 240 engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London and New York, 1899. ..... $0 50

Plants. A Textbook of Plant Diseases Caused by Cryptogamic Parasites. By George Massee. 12mo. cloth, 458 pages, fully illustrated. London, 1899. ..... $1 75

Smith's Work. With 211 engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth. 160 pages. London and New York, 1899. ..... $0 50

MUNN & CO., Publishers,
SCIENTIFIC AMERICAN OFFICE,
361 Broadway, New York.

THE
Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume $2.50 stitched in paper, or $3.50 bound in stiff covers

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.

PAGE

I. AERONAUTICS.—Regulations Concerning the Prize Offered by the Aero Club 20402

II. ARCHÆOLOGY.—Excavations in the Roman Forum.—1 illustration 20408

III. BOTANY AND HORTICULTURE.—The Abnormal Olive Trees of Majorca 20411

IV. CHEMISTRY.—The Products of the Incineration of Tobacco, as in Smoking a Cigar 20404
Constitution of Sulphites 20409
Some Inexpensive Home-Made Laboratory Apparatus.—3 illustrations 20412

V. CIVIL ENGINEERING.—Moving a Bridge.—2 illustrations 20402
Railroads in Asia.—1 illustration 20403
A Japanese Imperial Palace 20406

VI. COMMERCE.—Trade Suggestions from United States Consuls.. 20404

VII. ELECTRICITY.—Unusual Electrical Mishaps 20401
Energy of Becquerel Rays 20407

VIII. HYDRAULIC ENGINEERING.—Coolgardie, Australia, Water Pipe Line.—1 illustration 20401

IX. MARINE ENGINEERING.—Engines and Boilers of the "Deutschland."—2 illustrations 20409
The Japanese Battleship "Asahi."—2 illustrations 20413

X. MEDICINE.—Appendicitis 20410

XI. MINERALOGY.—Precious Stone Industry in the United States. 20414

XII. MISCELLANEOUS.—Numbering Hammer.—By ROBERT GRIMSHAW.—3 illustrations 20403
Philippine Weights and Measures 20404
Trade Notes and Receipts 20405
Selected Formulæ 20405
Medicated Waters 20407
Artificial Colors in Milk 20407
Advertising American Exhibits at Paris 20414
Mexican Cattle Industry 20414
Wagon Factory in Chemnitz 20414

XIII. NATURAL HISTORY.—Sociable Spiders.—4 illustrations 20410

XIV. PHOTOGRAPHY.—Some Useful Photographic Formulæ 20400
A Pneumatic Shutter for Optical Exposures 20405

XV. PRINTING.—Bronze Printing 20409

XVI. TECHNOLOGY.—Glass Bead Manufacture at Venice 20400
The Cutting of Diamonds at Amsterdam and the War in the Transvaal 20405

XVII.—TIME.—Where the Day Changes.—By Dr. A. M. W. DOWNING.—1 illustration 20412

XVIII.—WARFARE.—Some Details of Army Practice in Germany.—2 illustrations 20408

Automobiles

The SCIENTIFIC AMERICAN for May 13, 1899, is devoted mainly to illustrations and detailed descriptions of various types of horseless vehicles. This issue also contains an article on the mechanics of the bicycle and detailed drawings of an automobile tricycle. Price 10 cents.

The following copies of the SCIENTIFIC AMERICAN SUPPLEMENT give many details of Automobiles of different types, with many illustrations of the vehicles, motors, boilers, etc. The series make a very valuable treatise on the subject. The numbers are: 732, 979, 993, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1075, 1078, 1080, 1082, 1083, 1099, 1100, 1113, 1122, 1178, 1195, 1199, 1206, 1210. SUPPLEMENT No. 1229 contains a highly interesting article giving full data as to operating costs of horse and electric delivery wagons in New York city. Price 10 cents each, by mail. For sale by all newsdealers, or address

MUNN & CO., Publishers,
361 Broadway, - - - New York City.

BUILDING EDITION
OF THE
SCIENTIFIC AMERICAN.

Those who contemplate building should not fail to subscribe.

ONLY $2.50 A YEAR.

Semi-annual bound volumes $2.00 each, yearly bound volumes $3.50 each, prepaid by mail.

Each number contains elevations and plans of a variety of country houses; also a handsome

COLORED PLATE.

SINGLE COPIES - - - - 25 CENTS EACH.

MUNN & CO., 361 Broadway, New York

PATENTS!

MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had over *fifty years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Trade Marks, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge on application containing full information about Patents and how to procure them; directions concerning Trade Marks, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York
BRANCH OFFICES.—No. 625 F Street, Washington, D. C.